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# SCHOOLS OF FORESTRY

IN

GERMANY,

WITH ADDENDA RELATIVE TO A DESIDERATED  
BRITISH NATIONAL SCHOOL OF FORESTRY.

COMPILED BY

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## P R E F A C E .

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IN a *brochure* which I published in 1877, entitled *The Schools of Forestry in Europe: a Plea for the Creation of a School of Forestry in Connection with the Arboretum in Edinburgh*; and in a volume which I published last autumn (1886), entitled, *School of Forest Engineers in Spain, indicative of a Type for a British National School of Forestry*, I expressed and re-affirmed the opinion that, with the acquisition of that Arboretum with existing arrangements for study in the University and in the Watt Institute, there were required only facilities for the study of what is known on the Continent as Forest Science to enable these institutions conjointly, or either of them with the help of the other, to take a place amongst the most completely equipped Schools of Forestry in Europe, and to undertake the training of Foresters for the discharge of such duties as are required of them in India, in our Colonies, and at home.

The following volume shows what is implied in such a statement. No one of the schools described is considered by me of a type which should be followed in a British National School of Forestry; but the details may prove suggestive of much which might be done in the creation of such an institution.

I have ready for the press a companion volume on Forestal Arrangements in Germany, comprising statements of the views entertained in Germany in regard to the position of Schools of Forestry in the educational arrangements of the Empire, and in regard to the

appropriate site for such institutions ; details of arrangements and operations at Stations for Forestal Experimental Research at the sites of Schools of Forestry ; and a report of arrangements for the administration and management of State Forests in Bavaria. But the publication of the volume is deferred till the discussion of the expediency of establishing a British National School of Forestry may be more advanced.

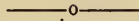
Information in regard to practicable arrangements by which such a British National School of Forestry as is indicated might to be created I have supplied in both of the treatises cited, and in evidence given by me before a Select Committee of the House of Commons appointed to consider whether by the establishment of a Forest School or otherwise our woodlands could be rendered more productive : which evidence in so far as it relates to this matter I have embodied in an Addendum to this volume.

By that Committee, as by one appointed by the previous Parliament, valuable information was collected, and on the 18th June, 1886, they agreed to report to the House of Commons:—‘ Your Committee have taken some evidence upon the matters referred to them, but have not had sufficient time to conclude their investigation on account of the dissolution of the present Parliament ; they have therefore agreed to report the evidence already taken to the House, and to recommend that a Committee on the same subject should be appointed in the next Parliament.’

JOHN C. BROWN.

HADDINGTON, 14th February, 1887.

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# SCHOOLS OF FORESTRY IN GERMANY.

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## INTRODUCTION.

THE history of forests and of forestry in Germany is not greatly dissimilar from that of forests and of forestry in France. Of this I have given some details in a volume entitled *French Forest Ordinance of 1669, with Historical Sketch of Previous Treatment of Forests in France*; and that forest ordinance marks the commencement of an era in the history of the treatment of forests in the one country and in the other.

Colbert of France, seeing the waste and destruction of forests going on in his day, gave expression to bitter feeling in words which have become famous:—'*France perira faute de Bois*'—France will perish through lack of wood.

And in 1721 Réaumur presented to the Academy of Science a Memoir in which in reference to this fear he says: 'The feeling of uneasiness is general, and it is perhaps only too well founded. The interests of the State demand at the least that the quantity of wood should not be diminished while the consumption is being increased. It is to be wished that the lands still left in wood should be put into the highest possible condition in regard to their value, and above all things, that their produce should not be allowed to fall off.'

And he showed how by a series of experiments it was

possible to ascertain at what age coppice woods could be felled with most advantage—regard being had to securing the greatest supply, and the best material, from the products of the forest.

In reference to the statement by Réaumur, which I have quoted, M. Parade has remarked, 'This is not the place to inquire whether the Government of that day did all that might have been done to attain the end pointed out by Réaumur; but let us tell, to the honour of science, that she was indefatigable in seeking out the proper remedies for the evil, and thus to allay the alarm of the country.'

These could only be found in a more scientific culture of trees; and science showed what were the measures to be successively adopted. These were, in a word, successive thinnings as a means of advancing and improving the growth of the wood, while obtaining an immediate produce; and the prolongation of the term of years allotted for the working of the forests to the exact period necessary to augment the products to the greatest extent in a given time. This had to be determined, and science has accomplished her task.

In 1757 a treatise on Forest Economy was published by Moser, in which he brought before his countrymen the method of management proposed by Réaumur four-and-twenty years before. And from statements made by Pfeil in a work entitled *Die Forsttaxation in ihren ganzen Umfange*, published in Leipzig in 1858, it appears that from the publication of this work by Moser date the earliest trials to determine with precision the future probable increase of wood in standing forests which were made in Germany.

In 1763 some of the works of Duhamel, one of the students of vegetable physiology in France, were translated into German by Schöllénbach, and published. About this time, say from 1760 to 1780, evils which were



inherent in the so-called *Regime à tire et aire* (that to which the French Ordinance of 1669 had special reference), were making themselves apparent on all hands. In Prussia, towards the end of the reign of Frederick the Great, there was issued an Ordinance relating to the management of forests, in which it was enjoined 'that the fellings, instead of clearing all away, should be confined to simple thinnings of the trees, having for their object the removal at most of *bad* wood and of *matured* wood in trees upwards of 70 or 80 years of age.'

And this has been considered an indication that it began to be perceived that the artificial restorations, the forced consequence of utter extermination, in the resin yielding woods were difficult of accomplishment when they had to be carried out on ground of great extent, and in circumstances little favourable to success.

Corresponding complaints on other points arose against the employment of the system in question in timber forests of beech, the restoration of which was not secured either by new shoots or by seeds; and a final grievance felt more particularly in the lesser states, in which the forest products constituted often a great part of the public revenue, came to demand a remedy for the great and grievous inequalities in the annual products which were obtained by the continued carrying out of the system.

There was no unwillingness to persevere in the mode of operation sanctioned by the Ordinance of 1669, technically called *à tire et aire*, which was unquestionably useful—namely, the orderly and regular exploitation of the forest; but it was indispensably necessary to modify the application of this, so as to secure the most perfect possible natural restoration of the forest, and to furnish to proprietors annual products pretty equal in amount or value.

The forests which had been subjected to *jardinage*, writes M. Parade, of Nancy, of whose historical sketch of the progress of the art of forest management the following

notice may be considered a free translation :—The forests which had been subjected to *jardinage*, in which were felled here and there such trees as promised to supply the material desired for whatever purpose this might be—sale, shipbuilding, house carpentry, or aught else, leaving all others to grow on, if haply they were not crushed by the fall of the felled tree, or broken down in the bringing out of the felled timber—presented standing crops of most unequal density, and without any well-marked gradation of age to which the system *à tire et aire* could be strictly applied without giving rise to many inconveniences, of which the most serious were these :—

1. A great inequality in the successive annual fellings.
2. Considerable loss of increase proceeding not only from great differences in the soil and in the denseness of the patches felled in successive years, but more especially from the circumstance that some portions were cut down too young, while in others many trees, and even entire clumps, were liable to decay before they came within the range of the regular series of fellings.

These were inconveniences to which it does not appear that any attention had been given in France, but which were felt by the foresters of Germany, and to remedy these inconveniences they devised in succession a number of measures, each of them, it may be, insufficient of itself to remedy the evil, but which, combined, resulted in constituting a set of rules, applicable, some to coppice wood and some to timber forests, which have given rise to the publication of numerous treatises on subjects which they embraced, or were connected therewith, which works proved useful not only at the time of publication, but also subsequently, inasmuch as they prepared the ground, and opened up the way for those master minds which have in later times definitely evolved the science of the art.

The rules referred to may be briefly described thus :—

1. In the management of coppice wood, they required the division of these into as many fellings of equal extent as there were years on the rotation to be maintained,

*excepting* in cases in which a very marked difference in the quality of the soil and the growth of the wood, combined with a necessity existing for obtaining annual products nearly equal in quantity, might require that the extent of the fellings should be made in some respect proportional to the production.

2. In the management of timber forests, these forests, which were no longer the forests *jardinées* of a former day, but which were coming, in whole or in part, under the operation of the system *à tire et aire*, were subjected to the following measures:—

1. A general cropping of the forest.

2. A classification, according to age, of all the standing crops, the oldest of which constituted together the group of exploitable woods, or of what were considered such.

3. The determination of the period of time necessary for the wood not yet matured to attain the predetermined age for felling.

4. The replacement during the successive years of this period of the products obtained from the group of workable woods, and with this in view the preparation of an estimate of the actual solid contents of these woods, and an estimate of their future cubic contents diminishing by progressive arithmetical decrease proportionate to the annual cuttings of the forest.

By these estimates it could be seen at a glance what were the cubic contents of the forest then, and what it was likely to be five years thereafter; ten years thereafter; twenty years thereafter; fifty years thereafter; or at any subsequentary intermediate period.

While the system of management of timber forests which has thus been described was being followed, it was found that the defects of the system were these:—

First of all, the end for the attainment of which the whole system was devised—namely, the establishment of a well-sustained relation of equalisation between the growth and the removal of trees was only imperfectly, and that very imperfectly accomplished. If, for example,

woods of a medium age were deficient in the series, the period which must elapse previous to the felling of the younger woods must necessarily be very protracted, and this must to a great extent tend to prevent the possibility of accomplishing the equalisation desired, as the old woods must be made to last to the end of this period, after which there would probably be a super-abundance; or, if on the contrary, the old woods were in excess, and those of a medium age were of corresponding fewer numbers a beginning would be made with an abundance which must ultimately experience a great reduction. A second and more serious defect of the system was the entire absence of any provision for the improvement of the state or condition of the wood, in so far as this might be effected by the gradation of the ages, and the order in which they should succeed one another on the ground; for such the forest was found in both of these respects at the beginning of the rotation, such must it have been found at the end.

In 1785 there appeared a remarkable work by Varenne de Fenille on the management of coppice woods, in which he thoroughly discussed the whole subject of production, and developed a theory in regard to the simple or absolute maximum of produce obtainable from coppice wood, and the compound maximum of small wood and of timber obtainable from such woods:—a theory which is still quoted in works on forest science and on forest economy, and which is known by his name.

Meanwhile the increasing scarcity of wood, and the importance of securing as large a revenue as possible from the sale of wood raised on Crown forests, combined to secure in Germany a measure of attention to forest economy which led to an important application of science to the regulation of forest operations. The attempts to regulate there what in France is called the system of *jardinage*, in accordance with which, as has been stated, trees are felled then and there, according as they seemed fitted to meet the requirements of the wood-

cutter, or showed symptoms of having begun to decay, had failed to accomplish what was desired. Subsequently the system of exploitation *à tire et aire*, according to which system of management the foresters divided into sections of approximately equal extent what are cleared in succession in periods of equal duration, so determined that by the time the last is cleared the forest will have been reproduced on the section first felled, had also failed; and evils which were inherent in the system manifested themselves in Germany as they had done elsewhere. These forcing themselves upon the attention of Hartig, a man deservedly held in great respect by students of Forest Science, he set himself to study these evils with a view to the discovery or the devising of some remedy.

About the year 1791 he published a treatise entitled 'Instruction in the Culture of Woods,' in which he gave his views on the clearing of woods, and on the reproduction of these by self-sown seeds. And in 1793 he published his developed system of forest economy.

The work of Hartig was carried forward by Cotta, under whom the modern system of forest economy may be said to have received its completed development, if it be understood that this does not imply that it has been so perfected as to admit of no further improvement, and to have need of none. In this, as in much besides, the highest ever leads to a higher; and improvements have been devised, while others are still desiderated, but such as it is it has become associated with the names of Hartig and Cotta. As in the rising tide the advance made by each successive wave may be noted, and even where no apparent advance is made, but rather an appearance of retrogression presents itself, the results in establishing the hold of the tidal wave on the strips of shore previously captured, may be made subject of record—so has it been in the development of forest science and forest economy; but, compared with what is done by each, the advance of the tide in its continuous flow so far transcends the advance made by each wave or wavelet in succession on the shore,

that it is this which chiefly arrests and engages attention, and calls forth remark; and so it is here.

Let all honour be rendered to each and all of successive promoters of forest science in bye-gone days! they laboured, and we have entered on their labours, enjoying by inheritance the fruits of these. But the passing allusions which have been made to some of them have been made solely with a view to make apparent the requirements for educated trained instructors to undertake the administration and management of forests, arising from the advancement of forest science and its embodiment in practical forestry, and the consequent necessity felt, if not also formally declared, for the organisation of Schools of Forestry in which the necessary education, instruction, and training might be obtained, which Schools of Forestry in their turn, in their earlier development, were really schools for foresters, and were made subservient to the still further development of the science and art of forestry. It was with this in view that they were called into being. In a companion volume to this on the Schools of Forest Engineers in Spain, I have had occasion to cite a work by Senior Don Carlos Castel y Clemente, in his '*Nocticia sobre la Fundacion y Desarrollo de la Escuela Especial de Ingenieros de Montes*,' published in 1877, an amplification of a memoir on the origin and development of the Special School of Forest Engineers in Spain, which he had prepared in accordance with orders received from the higher authorities of the State. In that he says:—

'In the seventeenth century there originated in some of the States of Germany the application of technical science to the treatment of forest masses. The rules, the aphorisms, and the whole of the directions which are comprised in the forestal knowledge of the ancients, are principles indefinite, obscure, uncertain, unconnected, destitute of method or systematized relations. Moser created in 1757 the first body of systematic teaching on the subject; and to the impulse given to this by him, and the weighty energy of Langen, Laspar, Zanthier, and others, are we

indebted for the formation of the first plans of scientific treatment of forests begun in 1731 in the forests of the Dukedom of Brunswick. He, in his time, Langen being the first to do so, perceiving the necessity of entrusting the management of the forests to a specially educated and trained body of officials, possessing all necessary knowledge and information, with a view to raising up a body of such men, established the first School of Forestry in Wernigerode in the year 1772. But others consider as the first school that founded by Zanthier in Ilsenberg, which was followed some years later by the establishment of that by Haase in Lauterberg, that which G. Hartig founded in Hungen in 1791, that in Zillbach by H. Cotta in 1795, and various others, all due to the efforts of individuals, and manifesting that essentially practical character which was so requisite to meet the requirements of the time and the conditions in which the distinguished founders were placed, but devoid of means which would allow of there being given to them the influence and development which afterwards became needful.'

While Cotta was preceeded, anticipated if you will, by others in feeling the need of appropriate instruction being given to foresters if there were to be obtained from them, and from their work, all the benefit to their country and to the world which these might be made to yield—who endeavoured to supply the desideratum, and did so according to their means and opportunity—it is the name of Cotta which has become most extensively associated with Schools of Forestry, and not improperly so, seeing that it is from the School of Forestry organised by him there has been developed and produced the advanced Schools of Forestry of the present day.

I have a feeling of great respect for Zanthier, who is said to have been the first systematic teacher of forest science and forest economy who taught on these subjects at Ilsenberg, a town in the county of Stolberg in Upper Saxony, situated not far from the Hartz mountains, and within the precincts of the old Thuringden forest.

But, as stated in the work by Senor Castel, which I have cited: 'The primary organisation of the schools founded in Ilsenberg, Wernigerode, Lauterberg, Hungen, Zillbach, Walterhausen, Rottenhaus, Castel, &c., in the period from 1766 to 1805, was that of several other private centres of instruction, which died out with their founders, or suffered the fate which befell these in the course of their existence. All these made themselves remarkable by the great impulse and development which they gave to the diffusion of forest science, and by their having raised up a numerous and distinguished body of men to assist and direct at a later time the work of bringing into order the forests of the districts in which they were situated. There stands out prominently amongst all these the school founded by Cotta. He, being charged with the reduction to an orderly condition of the Forest of Fishbach, spent some years in the execution of this work, and during these years giving theoretic and practical instruction to the young men who assisted him there: thus was instituted the new centre of forestal instruction at Zillbach. Such reputation was acquired by this establishment of modern times, that in 1795 there was granted to it a subvention from the State, thanks to which he was able considerably to augment the means available then for the prosecution of study.

'In 1810 Cotta was appointed Director of Forest Management in Saxony. He at once perceived and pointed out the lack which existed of a staff of skilled officials, who should execute and assist in the execution of his projects; and with a view to meeting this desideratum the promoted School of Zillbach was transferred to Tharand in 1811, and ceded to the Government on the 12th of May, 1816. Converted into a Government academy, and furnished with all necessary resources, the School of Tharand, devoted to the instruction of the forest engineers of the State, very soon flourished beneficently, attracting to study there the studious youth of many different countries, and serving as the sharp edge of a wedge for the general



diffusion of those truths which, spreading themselves a little later in different countries, proved the occasion of there being opened other schools which take pride in calling themselves daughters of the Saxon Academy.'

## CHAPTER I.

### THE ROYAL SAXONY FOREST ACADEMY IN THARAND.

THE organisation of a School of Forestry was a natural sequence of the endeavours of Cotta to improve the method of exploitation of forests. We lack the data needful to enable us satisfactorily to differentiate sequences, which were most probably consequences of a common cause. But this much is manifest from the records—to impart to practical foresters the results of his cogitations was at once necessary to the execution of his scheme, and to the acquisition of additional data which were needed for the full development of his views.

As has been intimated, in 1786 Cotta began to give instruction in regard to forests and forest products, and more especially in regard to the proper mensuration of woods and forests, and of forest trees, at Zillbach; and there in 1795 he organised a regular school for the study of such subjects.

This school may be considered as the germ of the first national School of Forestry, or as the seedling which having been transplanted elsewhere, developed into such an institution, and reproduced its kind. This school he may be said to have removed entire to Tharand, a beautiful watering-place, a few miles from Dresden, the capital of Saxony, on his being called to that kingdom as Forstrath and Director of Forstvermessung, or Forest Surveying. Thither followed him, along with his assistants the greater part of his students at the time, and they constituted the body of a new *Forstlehranstalt*, or School of Forestry, which he opened on the 24th of May of that year, 1811.

It has apparently been more or less the case with all the Schools of Forestry in Europe that while they have been designed primarily, and perhaps exclusively, to educate and train foresters for the discharge of their functions as foresters, forest warders, *Forst-meisters*, and inspectors of forests, they have, by the collection of observations made being brought under the consideration of learned men familiar with like phenomena, enjoying a quietude and retirement favourable to study, called to instruct others in regard to these very things, and taking a special interest in such matters, done much to advance the forest science, and to improve the forest economy of the day; and this was pre-eminently the case with the *Forstlehranstalt* and the *Forst Academie* of Tharand, under the direction of Cotta.

From an address delivered by Cotta at the opening of the institute it appears he laid down as a principle that it should supply to the young forester not only an opportunity to study the necessary accessory sciences, but also that which was peculiarly forest science, and the natural history of the game inhabiting the forest; and that this end could only be gained by a judiciously arranged combination of theory and practice. Apparently from the first he associated his students with him in his researches.

The first *Forstlehranstalt* virtually consisted of a number of forest commissioners, who in summer carried on operations in the different forests, under instructions from him as their chief, and in winter re-assembled at his residence, there to conduct, under his direction, the work of the forest bureau, and prepare plans of operations for the summer following. Such a group of educated, zealous, and laborious men supplied a most desirable instrumentality in the hands of such a master as he to be employed by him for such a purpose.

In a report which was made by Cotta to the Royal Privy College of Finance, under date of 12th September, 1815, he gives the following account of the progress and condition of the institute;—

‘Scarcely had I gone thither when so many young men took up the study of forestry and of the chase that the number of my auditors, including land surveyors in the service of the State, and selected members of the *jäger corps*, or huntsmen, during my first winter must have numbered about a hundred. In the following year, 1812, the collective number was considerably diminished, some of my older students having finished their course of study, some of the others leaving because they did not find here what they had in ample measure at the Zillbach school—a forest within a forest, for practice in forestry and in the chase, and many others leaving because they considered they had learned in the course of a year’s attendance all that they needed to learn. Still the collective number of my hearers in the winter of this second year, inclusive of surveyors, was between 70 and 80.

‘The war year, 1813, was, as it was to all other educational institutions, exceedingly detrimental to the *Forstlehranstalt* at Tharand; as the greater part of the students left the institute, and it was almost only the teachers who continued at their post. In the year 1814 some few students assembled, and bye-and-bye the lecture room gradually filled; but not before the beginning of the current year, 1815, when it was reported everywhere that my *Forstlehranstalt* was being changed into a Royal *Forst Academie*, and that thereby the practical instruction in the Tharand forest, should be entirely and more especially taken into account.’

The change referred to was brought under the consideration of the Privy Finance College in 1814, in consequence of a representation made by Cotta, and was understood to be carried out in accordance with his express desire.

In the so-called Private Institute of Cotta he himself gave instruction in all departments of forest science, forest technology, and forest botany; and Dr John Adam Reum, as second teacher, assisted in giving instruction in mathematics and in forest botany.

By a rescript of the 12th March, 1816, the transformation of the private institute into a national *Forst Academie*, under the conjoint direction of the Privy Finance College and the *Oberhofjagersmeister* — *anglice* Master of the Hounds, was completed.

Cotta, who was at the same time raised to the dignity of Oberforstrath, was nominated Director and forest teacher; as ordinary teachers to share the duty of instruction there were appointed Drs Reum and Krutzsch, both with the rank of professor; and instruction in what related practically to the chase and to forest mensuration, in plandrawing, in the German language, in forest law, and in financial economy, was entrusted to others, in all six persons besides the director and professors. For the purchase of books, specimens, instruments, and implements, 600 thalers was appropriated; for the support of poor but zealous students an annual allowance of 400 thalers was granted. The Academy had no forest of its own, but the forest lands of the Grallenberg Forest Circuit, and more especially the Tharand forest, was made available for practical instruction and demonstrations.

The lectures were begun in the month of June. The number of students who had been entered while it was under the direction of Cotta was 62, of whom 40 remained in the school, the others were employed as assistants in forest surveying and forest conservation.

By proclamation of 13th April, 1816, and by rescript of 10th June, 1816, the arrangements for study were authoritatively prescribed.

The curriculum of study embraced mathematics, pure and mixed, in all departments—arithmetic, geometry, trigonometry, mensuration, levelling, building, hydraulic engineering, in so far as this related to forestry, including dams, waterleadings, drinking places for man and beast, &c.;

Natural Science in all its departments, connected with forestry and the chase—zoology, forest botany, physiology of vegetation, with a more especial reference to the growth

of timber, orography, formation of earth and soil, mineralogy, physics, and chemistry, in so far as they might serve to illustrate anything and everything pertaining to forests ;

*Forstwissenschaft*, or Forest Science, inclusive of sylviculture, forest conservation, and profitable exploitation, forest technology, and the administration of forests ;

The chase, including the natural history of the game, the use of firearms, training of dogs, &c. ; and

Business requirements—correspondence, and bookkeeping, forest laws and game laws, and political economy, in so far as this related to forest products of all kinds.

The course of study was comprehensive and appropriate. In terms of the proclamation, practical instruction was to be the principal object aimed at in the instruction given to the students ; every lecture was to have practical demonstrations so connected with it, that what was learned in the class-room should be illustrated and expounded in the forest ; and if it should happen that any unusual forest operation, or proceeding in connection with the chase, should occur in the time appropriated to class studies, for that day the class studies should be suspended. The proclamation, moreover, expressly specified that the students should be called whenever the arranging of sites of felling, or of sylvicultural operations were to be fixed, or other important forest work was to be done ; and they were to be informed what were the reasons for the work being done, and for that course, and no other, being adopted. The more advanced students were, according to the judgment of the director of the school, to take part in the work, to do other special work prescribed for them, and otherwise to have opportunity of practising all of the manifold operations required in the forest. In view of this the *Oberforstmeister*, or chief forester of the Grillenburg Forest Circuit was, by special rescript, ordered not only to allow the students of the forest academy to take part in forest operations, but also to give to the subordinate officials the necessary instructions ; that they

should not only give notice to the Oberforstrath Cotta of the more important forest operations which were about to be undertaken, but also of all forest work, with specification of time and place, of which he should desire to be informed, that he might make the necessary arrangements for the students obtaining in the best way the practical instruction which these might be made to afford.

Moreover to those scholars in the academy who manifested satisfactory skill and interest in their studies an opportunity was to be given to be present at the revision in the larger forest circuits, that thereby their knowledge of forestry and general information might be expanded, as well as a closer insight into forest operations and forest management might be obtained. And with the same object in view they had once a-year at least to make a forest-excursion under the superintendence of a teacher, according to a pre-arranged plan, that they might be accustomed themselves to keep a journal of operations.

For fourteen years thereafter the *Forst Academie* was simply a School of Forestry, in accordance with a proclamation of 13th April, 1816, and was devoted exclusively to the scientific and practical training of foresters. By the terms of that proclamation, besides the instruction given in theoretical forest science, there was required to be given in it practical instruction in all departments of forestry and the chase, and this, in a course of two years instruction, and six months of special lectures. Real holiday rest was, according to the original prescription, enjoyed only during the weeks of Christmas and Easter; but besides this, in place of the usual spring and harvest holidays, six weeks after Easter and six weeks after Michaelmas were spent in practical work in the forest, or otherwise in forest excursions and in the varied works of the chase. It being afterwards objected that in the latter end of harvest there was a lack of opportunity for the students being exercised in forest work, in 1819 the harvest holidays were curtailed two weeks, and the pro-

gramme of study was so arranged that this should be resumed regularly on the 1st of November. And in like manner in 1828 the time spent in practical work was shortened, several years experience having shown that this was desirable; and the winter session was thereafter closed with the month of March; the month of April was given to practical work; and the summer session commenced on the 1st of May.

In 1822 there were instituted two distinct *abgangs prufungen*, or exit examinations, at the close of the curriculum—a lower one, for *Revierförsters* or district foresters, and a higher one for those aspiring to higher offices in the forest service. It was optional with the students to which of these they would submit themselves; and subsequently it was left free to the students to choose at what time they would submit themselves for examination.

To the Director of the Forest Academy it was entrusted to see that the teachers discharged their duties, to direct the general course of study in the Academy, to carry out, in concert with the other teachers, the discipline of the school, and so far as possible, personally to conduct the studies in forest science. In the absence of this official any of the teachers might be elected to discharge these functions.

The teachers were appointed by the Royal Privy College of Finance, and were of two grades—the ordinary academic teacher, with the designation professor, and assistant teachers.

The former met once a month under the presidency of the Director, and with the assistance of the *Forstmeister*, or master forester of the Tharand Forest Circuit, for the consideration of all that might relate to the good of the institution; and decisions were adopted in accordance with the majority of votes.

Subsequently a special uniform, indicative of connection with the forest service was appointed for all connected with the Forest Academy.

As means of education there were assigned to the



Academy all the Forest Circuit of Grettenburg, and more especially the Tharand forest, with at that time in all 9872 acres of forest land, and the pine woods in five *Reviere*s or districts, and the partially completed arboretum or forest botanic garden, with allowance for its maintenance, and provision for the purchase of necessary books, collections illustrative of natural history, implements, machinery, and apparatus, a physical and a chemical laboratory, a valuable geological museum, and a museum of woods and seeds. And from time to time additions were made to the buildings.

The attention given to the combination of practical training with scientific instruction was maintained; and the former had more time allotted to it.

I have before me a copy of the time-table or *Lehrstunden* for 1816 and 1817. In this, in accordance with the usage in Germany, is laid down the arrangement of classes meeting at the different hours of the day, but it is interesting now, chiefly as supplying, along with subsequently issued tables, authoritative prescriptions indicative of the gradations by which the existing system of study reached its present development. Successive extensions of the course of study continued to be made in the course of the fifteen years following.

In 1821 Professor Kruzsch made a suggestion that the object of this academy should be so extended as to embrace the study of rural economy. And seven years later he submitted to the Royal Privy College of Finance a scheme of instruction by which students could attend together classes in which were studied subjects required by both, and other classes for the subjects peculiar to each. He afterwards showed that such a combination of schools had been carried into practical effect both in the Kingdom of Bavaria and the Grand Duchy of Meiningen, and the measure was carried out by the appointment of Dr Schweitzer to a chair of rural economy, and the establishment of a garden of economic botany, a library of rural

economy, and a collection of models of agricultural implements, and other machines pertaining to rural economy. Subsequently, through the advice of the body of instructors, and of the Economical Society of Dresden, arrangements were completed for the erection of a combined Academy of Forestry and School of Rural Economy, and the foundation-stone of the extended buildings was laid by His Royal Highness Prince John, afterwards King of Saxony, accompanied by high officers of State, on the 25th June, 1829. The united colleges were opened on the 10th May, 1830; and the plan of the buildings was successively extended in 1846, in 1852, and in 1862.

About the year 1830 the arrangements of the Academy were extended to provide for the study of rural economy as well as of forestry being pursued in the institution; and on the 10th April, 1830, there was issued a *Lehrplan* or scheme of study, which continued to be followed for some sixteen years from that date.

This combination subsisted for forty years, but not without changes. For sixteen years the two schools were distinct; but in 1846 they were interfused, and constituted a combined School of Forestry and Rural Economy. But in 1870 the combination was terminated, and the Academy became again one for the study of forestry alone, and such it has continued ever since.

In the *Lehrplan* issued in 1830 the object of the School of Forestry was defined to be to train qualified forest economists, and more especially skilful forest masters and district foresters, for the Royal service; and the object of the School of Rural Economy to be to supply to young men devoting themselves to rural economy, or desiring to study rural economy as an auxiliary science, and to obtain sound practical knowledge of this, an opportunity of acquiring sound knowledge of the science required in the attainment of this.

In connection with the Forest Academy, two courses of study were now arranged—one extending over two years,

the other one which could be passed through in one year. The latter supplied the instruction deemed necessary for a district forester in the Royal service; the former, the higher instruction required by *forst-meisters*; while a course of three years' study was prescribed for those who aspired to superior positions in the forest service. According to a report of the institution, dated 4th November, 1839, the details were somewhat modified, but the principles were maintained, and the same may be alleged of other modifications which followed.

Several other changes affecting the age, position, &c., of the student, the staff of teachers, the direction of the studies, and the discipline of the school, were introduced. Important among these was the establishment of a Chair of Agricultural Chemistry, with a laboratory and provision for the study of chemistry, theoretical and practical, in all its applications to vegetation; and provision for the study of Veterinary Science, of Botany, Zoology, Entomology, and Natural History. The buildings were extended, and the educational appliances were increased.

In the middle of the century there were organised in Saxony several so called *Real-schulen*, in regard to which additional information will afterwards be given; here let it suffice to state that in these elementary instruction in physical science, as well as other branches of common school instruction, was given, and these *Real-schulen* were made available for increasing the efficiency of the School of Forestry by the provision made in them for the preparatory training of students. The two combined schools were again placed under different directors. Other changes in the internal arrangements were made affecting both the course of study and the discipline of the school. Increased attention was given to practical instruction in forestry; and with the establishment of these changes, was completed the first half-century of the operations of the School of Forestry in Tharand.

Modifications of the powers of the College Court of

discipline were made from time to time. Changes in the staff of teachers occurred through deaths and removals; and improvements, or what were designed to be such, were effected in the arboretum and other educational appliances of the institution; and from 1830 to 1845 the efficiency of the Academy steadily increased. From 1846 to 1857 was a time of civil commotion, and the institution suffered in consequence; but there were also changes made in the Plans of instruction. According to one issued on 5th February, 1846, it was arranged that, instead of taking the form of two united schools, it should take the form of one combined School of Forestry and Rural Economy, with a curriculum of study embracing two years, after passing through which aspirants for superior appointments in the service were required to spend a third year at the University.

The studies prescribed were these: of *Grundwissenschaften*, or foundation sciences, there were studied in class during the first year of the Course—Simple and applied arithmetic and algebra, for 4 hours a-week in summer; plane geometry and elementary mensuration, for 4 hours a-week in winter; physics, 4 hours in summer; chemistry, 4 hours in winter, with 1 hours *repetitorium*;\* geognosy, 2 hours in summer; mineralogy, 4 hours in winter; general botany, 4 hours in summer; vegetable physiology, 4 hours in summer; zoology, and special natural history of animals interesting to forestal and rural economy, 3 hours a-week in winter.

In the second year of the Course—Trigonometry and higher mensuration, 4 hours a week in summer; cubic mensuration and forest mathematics, 3 hours in winter; earth, soils, atmosphere, and climatology, 4 hours in summer; forest botany, 2 hours in summer; agricultural botany, 2 hours in summer; *Repetitorium* of natural history,

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\* The *Repetitorium* is an examination; but in so far as it has come under my attention it seems designed not to test the attainments of the students, but their defects; and this not for the humiliation of the student, but to show the teacher wherein his teaching has been deficient, either in itself or in view of the capabilities and attainments of different students.

and especially of botany, 2 hours in winter; entomology, 3 hours in winter; political economy, 5 hours during two months in winter.

*Hauptwissenschaften* or Special Sciences of Forestry in the first year of the Course—Foundations of forest science, 3 hours a-week in summer; forest defence, 1 hour in winter; the chase, 2 hours in winter; agriculture, 5 hours in summer; pastoral husbandry, 4 hours in winter.

In the second year of the Course—Sylviculture, 4 hours in summer; forest exploitation, or profitable utilisation, and forest technology, 3 hours in summer; forest taxation, or estimation of produce and probable proceeds, 4 hours in summer; forest history and literature, 2 hours in winter; State forestry, 2 hours in winter; forestal *Repititorum*, 4 hours in summer and 2 in winter; professional rural economy, 5 hours during three months in winter; practical rural economy, 3 hours in summer.

*Hilfswissenschaften* or Accessary Sciences during the first year of the Course—Bookkeeping and correspondence 2 hours in winter.

In the second year of the Course—Technology of rural economy, 1 hour in summer; veterinary surgery, &c., 3 hours in summer and 3 in winter; rural constructions and building, 2 hours in summer; legislation and jurisdiction relative to forest and rural economy, 2 hours in summer and 3 in winter.

Besides these studies in the class-room, there are given the following practical instructions:—Land Surveying, or practice in mensuration, two afternoons in summer; excursions for field studies in Natural History, 4 afternoons in summer; forest management one day weekly in summer and winter; exercises in shooting in summer, and in the chase in winter; demonstrations of rural economy on Saturdays. Practical instruction in garden and forest agriculture every year in the Botanic Garden in the months of April and October.

Changes or alterations in the plan of instruction thus prescribed could only be made with the permission of the Royal Ministry of Finance. With regard to the students, there was now a distinction drawn between those who entered with a view to attend the whole course of instruction given in the Academy, regular students of the Academy, designated in the corresponding language of the country as *Intaner*, Esoterics; and those who did not enter themselves as full students were called *Extraner*, a designation corresponding to *exoterics*: designations which have given origin to corresponding designations in Schools of Forestry in other lands. And along with this division of the students, there were introduced some changes in the conditions of admission to the Academy. Of every applicant, it was required that he should be at least 17 years of age, and have spent at least a year in practical work, pertaining to forestry or rural economy, and produce evidence of his possessing the preparedness necessary to his understanding the lessons to be given. The certificates required were those of birth and domicile, and of good character from the authorities of the place in which he had last resided, and of the school which he had last attended; and if not independent, a certificate from his father or guardian, attested by the local authorities, that he had their permission to attend the Academy.

Saxon subjects, moreover, who wished to fit themselves for the forest service of the country, and more especially for the charge of a forest circuit, were required, as they had been from the year 1849 onward, to show by submitting to examination, or by certificate from a national school, that they had attained the measure of scientific training required for entrance on the highest class of a gymnasium or *Real-schule* or other educational institution of the same standing; and also to establish by certificate, attested by the *Oberforstmeister* of the district, that they had acquired the required practical preparation by an apprenticeship of at least one year in the forests. Such Saxon subjects, moreover, as desired to fit themselves for

the higher departments of the forest service of the state, were required to produce from a national gymnasium a certificate of fitness for entering a University, and besides this, submit, if it should be desired, to an examination in mathematical science; and produce a certificate from the highest forest official in the district that he had for one year (or better for two years) been acquiring the requisite practical knowledge in a Royal Saxon *Forstrevier* or circuit, by personally engaging in the work.

All other students who, though they did not enter the forest service of the State, desired to go through the complete course of the Academy, and to receive on leaving, an exit certificate, were required to prove, by presentation of the necessary certificates from either Saxon or foreign schools, or by submitting to the corresponding examinations, that they possessed the required knowledge. But *extraner* were only required to show generally that they were qualified for attendance with profit on the lectures of the Academy.

With regard to other matters, the commencement of the summer session remained the entrance time for Saxons who desired to devote themselves to forestry, and go through the entire course with a view to subsequently entering the Royal State service of Saxons. Whilst *extraner* and students of rural economy, and with them those foresters who did not intend to enter the Royal State Service, might also enter at the commencement of the winter session. Some few unimportant changes were also made in regard to matters of discipline; but those arrangements which were finally adopted, and are now in force, seem alone deserving of special notice.

In anticipation of a jubilee festival to be held on 17th June, 1866, in commemoration of the opening of the School of Forestry at Tharand, by Cotta, fifty years before; and as part of the preparations for the due celebration of the event, there were prepared a number of

documents which were published as a 'Year Book' specially designed for that year—the year of jubilee.

In the frontispiece is given a plate of the Royal Saxon Academy for Forest and Rural Economy at Tharand, and in the first part of the volume is given a historical sketch of the Academy, divided into five marked periods, with an appendix containing a list of all the directors, professors, and other instructors who had served in the Academy; a second appendix contains the names of all the students who had attended the Academy, with their nationalities and time of attendance; and a third appendix supplies additional information tabulated to show the age of the several students at entrance, and several other details, but these relate more to the forest economy of Saxony, as developed by the studies pursued at Tharand, than to the development of the school itself, to which alone attention is being directed here.

These carefully prepared statistics of attendants and attendance during the first fifty years of the existence of the School of Forestry, supply all the information which could be desired in regard to the country, age, attainments, &c., of the student. But it may suffice here to state that, besides students belonging to the kingdom of Saxony, there were students from thirty-three other countries, including, I may say, every country in Europe, five students from America, and one from Britain.

The historical sketch is by Hofrath Dr Schober, Director of the Rural Economy Department of the Academy, and Professor of Rural Economy; and the historical divisions supply detailed information in regard to:

- I. The founding of the Academy and work previously done by Cotta in Zillbach;
- II. The work of the school from 1816, when founded, to 1829, during which period it was exclusively a School of Forestry, but had then an Agricultural School, of School of Rural Economy, established in the same building;



- III. This from 1830 to 1845, when the School of Forestry was combined with the School of Rural Economy ;
- IV. From 1846 to 1851, a period of war and commotion ;
- V. From 1852 to 1866, from the celebration of the 40th anniversary of Cotta's commencement of his work at Tharand, to the 50th anniversary and jubilee of the opening of the Forest Academy in Tharand as a State institution.

In the second part of this ' Year Book ' for 1866 are given, with reference to a map, geognostic and climatic descriptions of the region around Tharand within a distance of three hours' excursion on foot—on the east to Dresden, and on the west to the extreme limit of the Tharand forest towards Freiburg ; specifications of the altitudes of all the springs, streams, rivers, hills, and notable places in the district above the Zero of the Elbepegel or float measuring the flow of the Elbe at Dresden, and its level above that of the German Ocean ; a list of plants growing wild in the district, nearly 1000 in number, and of arborescent shrubs and trees in the Botanic Garden of the institution upwards of 500 in number ; an account of the distribution, physiognomy, and flowering season of the vegetation of the district, with arrangements of excursions in the vicinity and to greater distances, and notices of the new plants likely to be seen within the different hours spent on these different excursions.

In the third part are given several memoirs or reports which may be seen to relate rather to the forest economy of the country than to the history of the Academy, but which are intimately connected with this supplying manifestations of the great development effected in forest science and forest economy in the course of the previous half-century by the teachers and the taught in connection with the school.

The first is a report by Oberforstrath Dr J. F. Judeich, the Director of the Academy, and first teacher of

*Forstwissenschaft*, embracing—1. Finance; 2. The normal method of exploitation and its results; 3. The advanced and perfected method, the *Fachwerkesmethode*, devised by Cotta, and matured by Hartig.

The second is a report by Professor Roch, second teacher of *Forstwissenschaften*. On the development of silviculture in Saxony, from the establishment of the Academy in Tharand in 1816—in which are reported in succession the earlier neglect of silviculture and the reasons of this; the culture of the birch, the fir, the larch, and the beech; the earlier methods of renovation of forests; and the methods of culture adopted since 1816 in regard to sowing and in regard to planting.

The third is entitled 'A retrospect of the forestal and chemical physiological researches' undertaken in the laboratory of the Academy as an encouragement to the founding of forestal experimentation by Hofrath Professor Dr. A. Stoeckhardt. In this are discussed—1. Varieties of mountains, and the action of the weather upon them; 2. Varieties of soil; 3. Chemico-physiological researches; 4. Forestal technical investigations. The fourth is entitled 'The forest-borer of the newest construction for ascertaining increase of growth'; its importance and practical use for technical forest researches, taxation, administration, and exploration, by Hofrath Professor Pressler, in which are discussed—1. The advantage and necessity of fundamental and special observations of increase of growth; 2. The instrument in question, and the use of it, which the writer feels himself called on to recommend; and 3. Contributions made to the theory of technical calculations of increase, and observations of increase, with valuable appendices.

An incident connected with the jubilee in anticipation, of which these documents had been prepared, I may not pass without notice. In accordance with the usages of the nation, and the devout religious feelings under which the work had been begun and carried on, the jubilee falling

upon a Sabbath, the Sabbath was appropriated to the solemnity. It is a peaceful valley in which the Academy is situated ; but there on that holy day, at the very hour at which they had hoped that the students of the past and the present, and the patrons and friends of the institution, would proceed in procession from the Church of God to the Festal Hall, the van of the Prussian army entered the vale !

Throughout the previous century (the eighteenth), French students of forestry were steadily advancing to the discovery and device made by Hartig and Cotta.

But war, civil war, and foreign wars, to which that gave rise, compelled them to abandon their peaceful studies at the very time when a new era of forest economy was about to begin. And now, when after fifty years peace, their fellow-students of forest science in Germany were preparing to hold a jubilee in connection with their peaceful triumphs, they must give place to the requirements of war, and make way for the march of the warrior host !

The details which I have given of the history of the School of Forestry may be uninteresting to the general reader ; but I consider them not unimportant as indications of the growth and development of the institution from which the students of such establishments may learn much in addition to what may be learned from the study of a School of Forestry, created perfect in all its parts, as was Minerva, armed *cop à pie*, produced from the head of Jupiter. More recent details have not been given, because for the full appreciation of these, some knowledge of the circumstances which gave rise to the changes would have been necessary, and information in regard to these might have proved distasteful to some who otherwise may become interested in the subject. But I shall indicate immediately where additional information may be obtained, if it be desired.

Thus far the narration may be considered the history of

the origin and development through childhood and youth to manhood of the first National School of Forestry. The subsequent changes were not unimportant, but like the changes which pass upon man from early manhood to the full maturity of middle life, they are less marked than are some of those occurring in man, and in the earlier development of the school, within the same number of years in early life. In 1870 the School of Agriculture, or Rural Economy, engrafted upon it in 1830, was, after forty years of companionship, separated from it, and it was constituted again a School of Forestry alone. In a letter which I received in the summer of 1883 from the honoured Director of the School, Oberforstrath Dr Judeich, he mentions that in 1870 the agricultural department was removed; and by an order of 14th December, 1871, a new programme, or general plan of instruction, was introduced, in accordance with which the students were required only to spend half a-year in preparatory practice, and two and a-half years in class studies in Tharand. As preliminaries to admission they were required to produce a *Maturität*, or exit certificate, from a gymnasium or a *Real-schule* of the first class.

In the scheme of instruction referred to by Dr Judeich, which was sanctioned by the Minister of Finance on the 14th December, 1871,\* it is declared:—

(1.) That the design of the institution is to supply to foresters a comprehensive instruction in forest science, and the other sciences upon which this is based, or which are otherwise connected with it, so as to qualify them for the efficient discharge of their duties, and to promote the advancement of that science.

(2.) That for the time being the staff of teachers consists of the director, who is also teacher of forest science; a second teacher of forest science, who is also manager of the Tharand forest division; three teachers of physical

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\* Re-issued substantially the same in 1872, and again, with slight modification in 1879.

sciences; two teachers of mathematics, and teacher of rural economy and general economics, and of law and jurisprudence; and a manager of the arboretum, who is also instructor in fruit culture; and, as need may require, an adequate number of assistants.

(3.) The duties of the Director are to exercise—

1. The control of the studies in accordance with the the prescribed plan;

2. The control of the museums and educational apparatus, for which in subordination to him the several teachers are responsible in so far as they are severally concerned.

3. The immediate tenure of the property and inventories.

4. The payment of all accounts due from the funds of the Academy.

5. The calling of conferences of the college of teachers, and to preside and conduct these.

(4.) The ordinary teachers, under the presidency of the the director, constitute the College teachers.

The duties of this college, in the deliberations of which the official agent in what relates to discipline, has a seat and vote, embraces—

1. The examination of applications for admittance to the course of study followed at the Academy, and decision on the same.

2. Deliberation and decision in cases of discipline.

3. Deliberation and confirmation of the special *Lehrplan* or scheme of study for the session.

4. The approval and granting of applications for bursaries.

5. Deliberation and filling up of proposals to the Minister of Finance relative to the filling up of vacant situations of teachers, ordinary or extraordinary, and also of assistants.

6. All matters of importance which the Director declines on any ground to decide by himself, or which may be expressly assigned to the college by the Minister of Finance.

As a rule, meetings are held once a month ; but special meetings may be called at any time by the Director.

On proposal by the college, *privat-decanten*, tutors, or lecturers on special subjects, may be appointed by the Minister of Finance.

(5) To the College of Teachers, under the presidency of the Director, is entrusted the examination of certificates submitted by applicants for admission as students, and decision on the same. The trial and decision of cases of discipline, the consideration and decision of the *Lehrplan* or scheme and distribution of studies throughout the day, the session, and the curriculum of study, the sanction and allocation of money grants to students in aid of their education at the Academy, the consideration and decision of proposals to be submitted to the Minister of Finance relative to stipends to teachers and assistants, and in general, the consideration and decision of all matters which the Director may decline to decide on his own responsibility, or which the Minister of Finance may expressly assign to them for consideration.

(6.) The College of Teachers meet monthly, and at such other times as may be necessary, and summoned by the director.

(7.) *Privat docenten*, or tutors, may, by appointment of the Minister of Finance, be entrusted with specified duties.

(8.) The curriculum extends over two and a-half years, and embraces the following studies :—

#### I.—FUNDAMENTAL SCIENCES.

1. Physical Sciences—including (a) Chemistry, Agricultural Chemistry, Practical Chemistry ; (b) Mineralogy—Geognosy, with a special reference to the study of soils ; (c) Botany, Structure and Physiology of Plants, and special Forest Botany ; (d) Zoology, with a special reference to important animals injurious, or the contrary, to forest economy, embracing more particularly forest Entomology ; (e) Physics and Natural Philosophy ; (f) Meteorology.

2. Mathematics—(a) Cursory revision of Arithmetic and Geometry, with a special treatment of sections in each which may be of importance to the forester; (b) Analytical Geometry; (c) Differential and Integral Calculus; (d) Mensuration, including the drawing of plans.

3. Mechanics and Machinery.

4. Architecture, Hydraulic Engineering, and Road-making.

5. General Economics.

## II.—PROFESSIONAL SCIENCES.

1. History and Literature of Forestry. 2. Forest Culture, and Forest Conservation. 3. Forest Mathematics, measurement of standing trees and of felled timber, cubic increase of wood by annual growth, Forest financial reckoning. 4. Forest Economy and Forest Technology. 5. Forest Partition in accordance with the requirements of Scientific Forestry. 6. Forest Management and Administration, with a special reference to these as carried out in Saxony. 7. Forest Police. 8. Game Laws.

## III.—ACCESSARY OR COMPLEMENTARY SCIENCES.

1. Science of Finance. 2. Law and Jurisprudence. 3. Rural Economy.

4. Meadow Culture.

5. Fruit Culture.

The lectures are illustrated, when necessary, by practical exercises and demonstrations.

(9.) Amongst provisions for aiding in instruction are :—

1. The *Tharand Forest Revier*, or district, placed under the inspection of the director, and managed under the direction of the second teacher of forest science. 2. A Botanic Garden. 3. A Library. 4. Museums illustrative of Physical Science, Mathematics, and Forest and Rural Economy.

5. A Chemical Laboratory.

(10.) For forest excursions, which can be accomplished in one or in two days, and which are made weekly in summer, facilities are afforded by *Revieren* or forest divisions of the forest of Tharand beyond that connected with the Academy, and by the Dresden *Haide* or heath, and many other State forests and private woods easily reached by railway. And annually, at the close of the summer session, in the month of August, there is undertaken, under the guidance of one of the teachers, an excursion extending over ten days or a fortnight, which is not confined within the limits of Saxony.

(11.) The curriculum is begun annually on the 15th of October.

(12.) The holidays are Easter week, Christmas week, three full weeks in March, between the close of the winter session and the commencement of the summer session, and from the middle of August till the middle of October, the close of the summer and the commencement of the winter session.

(13.) The Academy is open both to the subjects of Saxony and others. Saxons desirous of entering the forest service of the State are required to submit—

1. A certificate of having completed the course of study at a Saxon gymnasium, or a corresponding certificate from some corresponding *Real-schule*.

2. A certificate that he has passed through a preparatory training for six months in some specified *Revier* or circuit of the State forests.

3. An extract register of birth.

4. If under age, a document from his father or guardian giving consent to his studying at the Academy.

Of others there are required only a passport or corresponding document; and if the applicant be under age a notarial certificate from a German Consul that he believes the applicant has the consent of his father or of his guardian to study at the Academy.

In the case of aspirants for employment in the forest service, it is further considered desirable that they should



give evidence that they have attained theoretical and practical instruction sufficient to enable them understand the prelections.

(14.) The entrant promises to obey the laws of the Academy, with a copy of which he is supplied. When his name is entered on the roll he receives a ticket certifying the same, for which he pays 5 *Thalers*.

In doubtful cases, the consent of the Minister of Finance is necessary to admission.

(15.) Subjects of Saxony pay 25 *Thalers* each half-year, and others 37 *Thalers* 15 *Groschen* for instruction, irrespective of the number of classes they attend. Students entering when half the session has passed pay only half fees; and students who are not preparing for the forest service of the State pay each session for the use of the chemical laboratory apparatus and re-agents:—

If used	4 hours per week,	.	3 <i>Thalers</i> .
"	8	"	5 "
"	16	"	10 "
"	24	"	15 "

(16.) Students desirous of employment in the forest service of the State submit to the following examinations:—

1. At the close of the first years' studies a written, and, at the option of the several teachers, also an oral examination on all the subjects which have engaged their study, except the higher mathematics; and any who do not obtain on the average at least the mark 2, or *Satisfactory*, cannot pass into the second division of the curriculum.

2. At the close of the curriculum a written and an oral examination on all the subjects studied in the third, fourth, and fifth sessions of the course, with the exception of the higher mathematics, meadow culture, and rural economy; and no one is passed who does not obtain the average mark 2, or *Satisfactory*, or who receives for the chief forest sciences—forest partitioning, forest culture,

forest economy, and forest mathematics—the mark *Unsatisfactory*.

3. Exceptional cases may be committed to single teachers to examine on specified subjects.

4. At both of the examinations students may voluntarily offer themselves for examinations on the subjects, the examination on which is not obligatory—the higher mathematics, meadow culture, and rural economy.

With students who have not determined to seek employment in the forest service of the State it is optional to submit to examination in any, or all, or none of the subjects of study.

(17.) The marks assigned as the result of examination of these—

Unsatisfactory,	.	.	.	0
Scarcely satisfactory,	.	.	.	1
Satisfactory,	.	.	.	2
Good,	.	.	.	3
Very good,	.	.	.	4
Distinguished,	.	.	.	5

And there is entered the average yielded by the marks obtained in the whole of the examinations; but this is only granted when examinations on all the prescribed subjects has been undergone.

The conduct marks are these—

1. Reprehensible.
2. Nothing very culpable.
3. Irreproachable.

Students not submitting to examination may obtain certificates of the time they attended, the classes in which they studied, and of their conduct; and if they submit to examination on one or more subjects, certificates of their appearance in these are given.

(18.) Candidates for the State service failing in one or other of the examinations, may present themselves for

examination a second time. But with a second failure they lose all title to such employment.

(19.) For promising candidates of limited means there are provided six whole and six half free scholarships—holders of the first paying no fees, holders of the second paying half fees; and a fund has been created from which a certain number, distinguished for their zeal, progress, and good behaviour may obtain an allowance of from 10 to 50 thalers towards their personal expenses. All applications in both cases are submitted to the Minister of Finance.

Deserving students of limited means, who have a long journey to make at the close of each session, may have granted to them, by decision of the teachers, from 60 to 100 thalers for travelling expenses. And there have been founded scholarships obtainable in accordance with prescribed conditions.

(20.) Students are required to conform to the rules of the Academy. Each must be in his place at latest within ten minutes after the hour of lecture. If later, the case is reported to the Director. The provided means of study must be used in accordance with the regulations, and all injuries must be made good. Everything whereby the laws or ordinances of the direction, the amenity of the place, the public safety, order, and peace, may be compromised, respect towards officials, superiors, or teachers, impaired, or private persons injured, must be avoided.

(21.) The punishment to which transgressors are liable are these—

(a) Reproof according to sentence, with or without report to the officers of justice, or to the college of teachers, in presence or in absence of the other students, with or without report to parents or friends.

(b) Forfeiture of money grants.

(c) Imprisonment.

(d) Warning, with threatening of expulsion from the Academy.

(e) Expulsion.

Two or more of the punishments may be combined; and expulsion is always to be reported to the relatives.,

There is issued at the commencement of each session a *Lehrplan*, or scheme of study, specifying how the lecture hours of each day are occupied. The following are translations of copies of those with which I was supplied:—

LEHRPLAN OF THE ROYAL SAXON FOREST ACADEMY AT THARAND,  
SUMMER SESSION, 1877.

Hours of the day.	MONDAY.		TUESDAY.		WEDNESDAY.	
	Course 1. 2nd Session.	Course 2. 4th Session.	Course 1. 2nd Session.	Course 2. 4th Session.	Course 1. 2nd Session.	Course 2. 4th Session.
7-8	Differential Calculus.	General Economics.	Geognosy	Forest Protection.	Forest Exploitation.	Forest Exploitation.
8-9			Anatomy & Physiology of Plants.	Special Forest Mathematics.	Agricultural Chemistry.	
9-10	Geognosy.	Sylviculture.	General Mathematics, Part 2.	Forest Botany.	Exercises in Mensuration.	Forest Botany.
10-11		Forest Exploitation.	Mensuration.	Forest Exploitation.		
11-12		Meadow Culture				
2-3		Roadmaking.	Plan and Architectural Drawing.	Exercises in computing Produce and Products of Forests.		Exercises in Mensuration
3-4	Geognosical and Mineralogical Excursions.	Practical Zoology.				
4-5						
5-6						

LEHRPLAN OF THE ROYAL SAXON FOREST ACADEMY AT THARAND—(Continued.)

SUMMER SESSION, 1877.

Hours of the day.	THURSDAY.		FRIDAY.		SATURDAY.	
	Course 1.	Course 2.	Course 1.	Course 2.	Course 1.	Course 2.
7—8	2nd Session. Zoology of Vertebrates.	4th Session. Forest Protection.	2nd Session. Zoology of Vertebrates.	4th Session.	2nd Session.	4th Session.
8—9	Anatomy and Philology of Plants.	Special Forest Mathematics.	Geognosy.	Agricultural Chemistry.	Excursions and Practical Exercises.	
9—10	General Mathematics. Part 2.	Agricultural Chemistry.			R E M A R K S.	
10—11	Practical Study of Physiology of Plants.	Forest Exploitation.		Forest Botany.	The Library is open on Tuesdays and Fridays from 10 to 12 o'clock.	
11—12					In Summer, on Tuesdays, as well as Fridays, the Chemical Laboratory is open, and at the disposal of Students for practice.	
2—3	Botanical Excursions.		Practice in Chemistry.		The Summer Session begins on 9th April, and closes in the middle of August.	
3—4					The Winter Session begins on the 15th August.	
4—5						
5—6						

# LEHRPLAN OF THE ROYAL SAXON FOREST ACADEMY AT THARAND.

WINTER SESSION, 1877-78.

Hours of the day.	M O N D A Y.		T U E S D A Y.	
	Course 1.	Course 2.	Course 1.	Course 2.
8-9	1st Session.	3rd Session. General Economics	1st Session	3rd Session. Sylviculture.
9-10		Mensuration. Part 2.	General Zoology.	Special Forest Mathematics. Forest Administration.
10-11	Mineralogy.	Integrate-Calculus	Botany.	Mechanics and Machinery. Meteorology.
11-12			Physics.	Entomology.
2-3		Entomology.	Plan Drawing.	
3-4	General Mathematics. Part 1.			Jurisprudence.
4-5		Jurisprudence.		* <i>Repetition</i> of Forest Mathematics

\* *Repetition*, it has been intimated on foot-note (*ante* p. 22), differs from a *revisal* or examination in thus—*Revisal* does not necessarily imply examination. *Examination* is generally employed to test the attention given by the student. *Repetition* is an examination to test the intelligibility of the lectures by the impressions received by the students.

LEHRPLAN OF THE ROYAL SAXON FOREST ACADEMY AT THARAND—(Continued.)  
 WINTER SESSION, 1877-78.

Hours of the day.	W E D N E S D A Y.			T H U R S D A Y.		
	Course 1.	Course 2.		Course 1.	Course 2.	
	1st Session.	3rd Session.	5th Session.	1st Session.	3rd Session.	5th Session.
8—9		History of Literature and Forest Science.		Chemistry.	Sylviculture.	Forest Police.
9—10	General Zoology.	Special Forest Mathematics.	Forest Police.		Special Forest Mathematics.	Meteorology.
10—11	Botany.	Mechanics and Machinery.	Meteorology.	Botany.	Practical Chemistry.	Laying out of Forests.
11—22	Mineralogy.	Mensuration. Part 2.		Zoology.		
2—3		Entomology.				
3—4	General Mathematics. Part 1.		Jurisprudence.		Plan Drawing.	Jurisprudence.
4—5						Forest Mathematics <i>Repetitorium.</i>



LEHRPLAN OF THE ROYAL SAXON FOREST ACADEMY AT THARAND—(Continued.)

WINTER HALF-YEAR, 1877-78

Hours of the day.	FRIDAY.			SATURDAY.		
	Course 1.	Course 2.		Course 1.	Course 2.	
	1st Session.	3rd Session.	5th Session.	1st Session.	3rd Session.	5th Session.
8—9	Chemistry.	Sylviculture.		The Chase.	General Economics.	
9—10		History and Literature of Forest Science.	Forest Administration.			
10—11	General Mathematics. Part 1.	Practical Chemistry.	Laying out of Forests.	Physics.	Practical Vegetable Physiology.	
11—12		Integrate-Calculus.				
2—3		Practice of Chemistry.				Encyclopædia of Rural Economy.
3—4					Practical Chemistry.	
4—5						

In the *Lehrplan* there is given also, under each subject of lecture, the name of the lecturer.

In the communication received from Dr Judeich, already referred to, he mentioned that in 1869 there was founded, through the enterprise of Professor Nobbe, an Agricultural and General Physiological Experiment Station.

Of the attendance of students, subsequently to the Jubilee, he gives the following returns:—

Year.	SUMMER SESSION.				WINTER SESSION.			
	Students of Forestry.		Students of Rural Economy.	Total.	Students of Forestry.		Students of Rural Economy.	Total.
	Saxons.	Foreigners			Saxons	Foreigners		
1866	55	20	17	92	56	19	13	88
1867	65	24	12	101	64	23	14	101
1868	52	24	11	87	49	25	12	86
1869	29	18	8	55	26	26	6	58

After this, the Rural Economy Department having been withdrawn, there were only students of forestry in attendance.

Year.	SUMMER SESSION.			WINTER SESSION.		
	Saxons.	Foreigners	Total.	Saxons.	Foreigners.	Total.
1870	20	23	43	19	30	49
1871	28	26	54	26	29	55
1872	32	28	60	36	25	61
1873	17	18	35	23	30	53
1874	20	32	52	29	34	63
1875	20	26	46	30	45	75
1876	23	37	60	33	51	84
1877	27	34	61	34	59	93
1878	26	51	77	38	72	110
1879	25	53	78	46	75	121
1880	33	58	91	46	80	126
1881	37	50	87	57	69	126
1882	41	55	96	66	64	130

The occasion of my visit to Tharand was my attendance at a Congress of German foresters, professors of forest science, and administrators of forests, held in the neighbouring capital, Dresden, in the autumn of 1881. I had been made acquainted years before with the history of the Academy. I found Tharand all that I had been led to picture it to myself; and I shall not soon forget the intercourse I enjoyed with the Director and his colleagues, which intercourse was all too short to satisfy the cravings which it gratified. I found Tharand, as I had read it described by another:

‘Tharand is beautifully situated at the junction of three valleys, from two of which flow streams which unite and flow through the Planenschegrund into the Elbe. The neighbourhood abounds with pretty romantic walks. From the ruins of the old castle, the remains of a hunting seat of the ancestors of the Royal Family of Saxony, which may be reached in ten minutes from the inn, you look down from a promontory of rock on which it is perched into a deep and picturesque valley on either side.

‘The Forest Garden is a nursery forest containing, it is said, 1000 different species of trees and shrubs attached to the Forest School. From this a fine view may be obtained, and there are pretty walks in it. The same may be said of the Heilige Hall, an avenue of beech trees.’

In the history of the Academy at Tharand, published on the occasion of the Jubilee, it is stated in the conclusion of the account given of the fourth period of the history:— ‘On the 17th of June, 1851, forty years after the removal of Cotta’s private institute from Zillbach to Tharand, the unveiling of the bust of the late Privy-Oberforstrath Cotta in the Botanic Garden was solemnised. On the same day the bust of him by A. Reum was, in a becoming manner, erected and consecrated in the centre of his creation, and in a place where he often taught—in front of the so-called *Rundetheile*, or circus, in the Garden.’

The first-mentioned bust was presented by the Cabinet Minister Count von Einsiedel; the latter was erected at

the instance and expense of several admirers of the distinguished man.

On the summit of the tree-clad hill, which forms a background to the Academy, stands the monument in question, surrounded by a wide circle of noble trees planted as saplings on that occasion by admiring grateful disciples, as a tribute to the honoured founder of the Academy. Thither the members of the Congress were conducted, many of us knowing not why or whither, and many a quip and jest, and hilarious laugh, seasoned our reasonings by the way ; but as we drew near, and realised the scene, every voice was hushed, even the footfall was made in silence profound, and collecting in the sacred enclosure, while more than one was apparently engaged in silent worship, fancy seemed to hear once more the voice, heard by the beloved disciple of our Lord in Patmos : ' And I heard a voice from heaven saying unto me, write : Blessed are the dead which die in the Lord from henceforth ; Yea, saith the Spirit, that they may rest from their labours ; and their works do follow them.'

## CHAPTER II.

### THE ROYAL FOREST ACADEMY AT NEWSTADT- EBERSWALDE.

THE route which I followed in going to the Congress of German foresters and others held in Dresden in 1881, my attendance at which gave me an opportunity of visiting the Royal Saxon Forest Academy at Tharand, led me through Berlin, and I availed myself of the opportunity to visit the Royal Prussian Forest Academy at Neustadt-Eberswalde. It was one of the first of the schools of Germany established after that of Tharand. It is situated on the Finow, a stream which is here connected by a canal, with the Oder on one side and with the Havel on the other. It is passed by the railway connecting Stettin with Berlin.

The following is a translation of a historical sketch of the parent school, supplied some years ago by Dr Dankelmann, the director of the institution :—

‘As early as the close of the eighteenth century there were, now and then, at the University of Berlin (if there happened to be qualified persons), lectures given on the science of forests, without, however, establishing a permanent professorship for this object, or imposing conditions upon candidates for the public forest service for the completion of their studies in forest science. It was then deemed sufficient to be conversant with the keeping of accounts, mathematics, and the science of natural history, thus entirely leaving technical education to be acquired by practice. The number, however, of qualified employées, thoroughly and systematically educated with regard to technical knowledge, growing, in

consequence of this system, constantly less and less, it was deemed proper to establish, in 1821, an Academy for forest instruction at Berlin.

‘Dr Friedrich Wilhelm Leopold Pfeil, then Oberforstrath, was intrusted with the superintendence of this institution, which, although organically not connected, entered into such association with the university as to employ the professors and means of instruction belonging to the latter, for teaching the fundamental and accessory sciences, while the lectures on the principal studies were given by technical instructors. This organisation, however, soon proved inadequate. On the one hand the much-extended study of the fundamental accessory sciences produced an injurious effect upon the principal studies, and, on the other, there being no suitable forests in the immediate neighbourhood of Berlin, the theoretical lectures could not be explained, nor supplemented with practical illustrations. The more distant, but unfrequent excursions and forest journeys, could not efficiently remedy this inconvenience, and they proved insufficient to secure a close connection between the theoretic study and the living instruction of the forest.

‘On the superintendent’s advice, based upon these considerations, and strongly supported by the intercession of Wilhelm and Alexander von Humboldt, the Academy was, in 1830, removed to Neustadt-Eberswalde, and named the High Institution for Forest Science. In the immediate neighbourhood of this place there are two large forest districts which offer the students in high degree a fine opportunity for becoming familiar with their various features. Dr Pfeil continued to act as superintendent, and, at the same time, he was intrusted with the administration of the said districts. In addition to Pfeil, who taught the science of forestry proper, there were appointed two other professors, one for the whole department of natural sciences, and the other for both mathematics and geodesy. In 1830 a chair was established for Prussian jurisprudence, with particular reference to forest matters,

and, in 1851, a second teacher of forest science was appointed.\* Pfeil remained in his position as superintendent till autumn, 1856, when he was succeeded by Oberforstmeister Grunert. On the latter's resuming his former position in the administration of public forests, the direction of the institution was conferred upon Dr Dankelmann, the present incumbent. Since 1866 very important changes have taken place in the organisation of the Academy, with a large increase in the number of instructors. At present there are officiating at the Academy, besides the Director, who occupies the first chair for forest science, two more teachers of this science, a teacher of mathematics, physics, mechanics, and meteorology; one of chemistry, mineralogy, and geognosy; one of botany, one of zoology, and one of jurisprudence; and, in addition, a royal chief forest officer, as assistant teacher of roads, geodesy, and plan-drawing; and also a chemist as assistant teacher of geology.'

The regulations for the Royal Forest Academy at Newstadt-Eberswalde, and that at Münden in Hanover, at present in force, were issued by the Minister of Finance under date of 5th April, 1875. In accordance with these:—

The schools are under the control of the Minister of Finance. The Oberland Forstmeister is curator of both. The staff of teachers in each is composed of a Director, appointed by the King, who is instructor in forest science, a second professor of forest science, a teacher of mathematics, a teacher of natural science, and a teacher of law, in its relation to forests and to game; and permission to any one to act as college tutor (*Privatdocent*) in a Forest Academy may be given with the sanction of the Minister of Finance.

The arrangements in each of these Academies for the study of every department of forest science is complete, but part of an autumn vacation may be spent by the

\* Notwithstanding this, those who were destined for the superior functions of inspection and conversation had, besides their two years and a-half at the school, to follow a course of some years at the university.—(See *Revue des Eaux et Forêts*, May, 1876.)

students at one in the practical forest operations carried on in connection with the other.

The course of study extends over two and a-half years, and embraces fundamental science, special science, and accessory science.

Under the head of Fundamental Science are included—

1. Physics, Meteorology, and Mechanics.
2. Chemistry, inorganic and organic.
3. Mineralogy.
4. Land Surveying and Geology.
5. Botany, including the structure, physiology, and pathology of plants; special forest botany and microscope demonstrations.
6. Zoology, including special zoology, with a reference to forest economy and to game, and especially to forest insects.
7. Mathematics, including arithmetic, plane and cubic mensuration and trigonometry, elements of analytical geometry, elements of the higher analysis, land surveying and chart drawing.
8. Political Economy, with a special reference to forests.

The special technical sciences in which instruction is given are these—

1. History and literature of forests.
2. Local or national doctrines of forests.
3. Exploitation of forests.
4. Forest protection.
5. Forest products and forest technology.
6. Forest taxation, mensuration of wood, forest mensuration, and all of those with special reference to Prussian usage.
7. Valuation of forests and forest statics.
8. Forest statistics and forest management, with a special reference to the classifying of forests in Prussia.
9. Forest rights, usages, and servitudes.

The Accessory Sciences are—

1. Law, in theory and practice; Prussian law, civil and criminal, and civil and criminal processes.
2. Forest-road making.
3. Game laws and the chase.

The study of fundamental and of accessory science is strictly limited to what may be necessary to a scientific practice of forest economy, but it embraces all that is required for this. The means of instruction are—

1. The Royal forest districts of Biesenthal and Liepe, a *Secherie* near Newstadt-Elerswalde, and those at Gahrenberg



and at Cattenbuhl, near Münden. 2. Seed-kiln at Newstadt-Eberswalde. 3. Botanic Garden, and Arboretum illustrative of Forest Economy. 4. Chemical laboratories; and cabinets of collections illustrative of. 5. Natural Philosophy; 6. Land surveying; 7. Forestry and the chase. 8. A Library.

The course of study extending over two years and a-half, is commenced with the summer session; but students who have no intention of entering the forest service of Prussia may enter either then or at the beginning of the winter session. The summer session extends from Easter till the 20th of August; the winter session from the 15th of October till fourteen days before Easter. The arrangements for lectures during each session is submitted to the Minister of State some weeks previous to the commencement of the session; and it is published for general information.

There are required of applicants for admission certificates:—1. Of having passed with credit through a German Gymnasium, or Prussian High School of the first class; 2. Of not exceeding twenty-four years of age; 3. Of a fitness for a forest life; 4. Of blameless moral character; 5. Of adequate means of support while at the Academy; 6. Of having passed a university examination, or other equivalent examination, in land measuring; and of having spent a seven months preparation in forest work.

Students from the Huntsman's Corps (*Fieldjagerkorps*) required to attend the Academy are required only to produce the certificate No. 3, and to submit to the Director certificates corresponding to Nos. 1 and 6; and of students who do not intend to enter the forest service of Prussia there are required only the certificates Nos 4, 5, and 6.

Forest students and forest candidates, who have completed their curriculum, are permitted, without charge, to go on the excursions, and to avail themselves of the collections, &c., belonging to the Academy as means of

instruction, so far as practicable, on authority obtained from the Director; and also to attend particular lectures, &c., as *Hospitanten*—but the Director is authorised to require of such, if he think proper, a fee of 9 marks for every class attended; and others, who have studied  $2\frac{1}{2}$  years in a foreign School of Forestry may be admitted to the same privileges as *Hospitanten* on payment of 10 marks to the general fund as a fee for entrance ticket or matriculation.

The entrance fee to either of the Academies is 15 marks, and for transference from the one to the other 10 marks; and the fees for each session are 75 marks. But members of the *Feldjagerkorps*, and of the *Jagerbataillone*, or State-huntsman, required to attend the Academy, and others holding *Ladenberg bursaries*, are exempted from payment of these fees.

Appropriate means of maintaining discipline are prescribed; and regulations are laid down in regard to students leaving the Academy; and bye-laws have been added under the same authority regulating the use to be made of the various educational collections, &c., belonging to the Academy.

Previous to the promulgation of these regulations in 1875 there were in force corresponding regulations promulgated under date of 1st March, 1868. These were then superseded; and under date of 30th June, 1874, there were issued prescriptions for the training and testing of officers employed in the Royal Forest Service of Prussia; but this subject is not one which comes under consideration here, which is solely the educational arrangements in the Forest Academies, by which in part that training was provided for. There is, however, one point on which a word of explanation may be necessary.

According to an Order of the Minister of Finance of 6th April, 1871, and to sec. 1 of the prescriptions referred to—As an examination in land-measuring is required to precede that in regard to practical forestry, admission to that

examination must be preceded by two years occupation with land measurement and levelling, and these two years, in the case of students at the Forest Academy, intending to enter the forest service is, along with seven months attendance at the Academy, to reckon as one year in the two and a-half years embraced by the curriculum.

In accordance with the practice generally adopted by Schools of Forestry in Germany there is issued before the commencement of each session a programme of the studies to be pursued, for the information of any who may have under consideration the expediency of seeking admission, as well as of those who have already entered on the curriculum. The following is a translation of that issued for the winter session 1882-83, at which there were in attendance about 50 Prussian students, besides foreigners.

First section of the course of study, designed for students of the first year who had entered the school at Easter 1882.

### I. FOREST ECONOMY.

Culture of Woods.—Five hours a-week : and so with the others. Wood-Cutting.—One hour a - week. Forest excursions.

### II. NATURAL SCIENCES.

Meteorology and Climatology.—One hour. Inorganic Chemistry.—Three hours. Organic Chemistry.—One hour. Mineralogy.—One hour. Chemistry applied to Technology.—One hour.

General Botany, Anatomy, and Vegetable Physiology.—Four hours. Structural Demonstrations by aid of the Microscope.—Two hours. Zoology.—Invertebrate Animals. Five hours.

### III. MATHEMATICAL SCIENCES.

Repetitions and Exercises in Mathematics.—One hour. Geodesy.—One hour. Political Economy and Jurisprudence, and Civil and Criminal Law.—Two hours.

Second section of the course designed for students of the second year who had entered the school at Easter 1881.

### I. FOREST ECONOMY.

Redemption of Servitudes.—Two hours. Exploitation of Woods and Technology.—Three hours. *Rentabilitaetslehre*, or estate and area, and theory of the greatest return as an investment.—Two hours. History of Sylviculture.—Two hours. Cubic Measurement of Woods.—One hour. Road Making, and Establishment of Network of Forest Paths for the bringing out of Wood.—Two hours. Examination on Forest Economy.—One hour.

Forest excursions, with exercises in practice, consisting of management of a regular timber forest; management of a forest by *Jardinage*; and redemption of servitudes burdening a large forest of woodland.

### II. NATURAL SCIENCES.

*Repititorium*\* of Chemistry, of Mineralogy, and Geodesy. One hour. Practical operations in the application of Chemistry to the analysis of soils.—Two hours. *Repititorium* of Botany.—Two hours. *Repititorium* of Zoology.—One hour.

### III. MATHEMATICS.

Elements of the Higher Analysis.—Two hours. Elements of Analytic Geometry.—One hour. Political Economy and Jurisprudence. Commercial Management of Forests.—Two hours. Civil and Criminal Law.—Two hours a-week.

The following is a translation of the *Unterrichts-plan* or programme of study for the complete curriculum of two years and a-half. It is one of an earlier date, extending from Easter 1870, to autumn, 1873. These are issued annually, but they are essentially the same.

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\* *Repititorium*, as I have already intimated, is a term applied to class examinations, designed less to demonstrate the height of attainments made by the students than their defects; and this less with a desire to expose the deficiency of the student than that of the instruction given, that the teacher may know what he should say more or say differently than what he has said.

The following summary of the instruction given is embodied in a Report upon Forestry prepared under the direction of the Commissioner of Agriculture of the United States Government for 1877 by Dr Franklin B. Hough.

'As it may afford some interest in mentioning the number of hours assigned during the five term-times to the different lectures we give the following table:—

Fundamental Sciences.		Principal Sciences.		Secondary Sciences.	
Objects of instruction.	Whole number of hours.	Objects of instruction.	Whole number of hours.	Objects of instruction.	Whole number of hours.
NATURAL SCIENCES.					
General and theoretic chemistry .....	32	Cultivation of forests.....	80	Civil law.....	72
Special igno- ramic and organic chemistry applied.....	80	Forest implements.....	20	Criminal law.....	32
Physics and meteorology.....	80	Geograph forest botany. ....	48	Civil criminal law suits and constitutional rights.....	40
Mineralogy and geognosy.....	60	Protection of forests.....	32	Jurisprudence.....	36
Definition of minerals and rocks.....	20	Forest usufruct and technology .....	80	Total.....	180
Reviews for inorganic natural sciences.....	16	Forest surveying.....	20	Construction of roads.....	32
Botany in general, and forest botany in particular.....	64	Appraising forests.....	80	Hunting.....	32
		Calculation of the value of forests and forest statistics.....	32		

## NUMBER OF HOURS GIVEN TO THE DIFFERENT LECTURES—Continued.

Fundamental Sciences.		Principal Sciences.		Secondary Sciences.	
Objects of instruction.	Whole number of hours.	Objects of instruction.	Whole number of hours.	Objects of instruction.	Whole number of hours.
Anatomy of plants, vegetable physiology and pathology .....	60	Administration of forest and hunting.....	48	Shooting exercises, two hours each.....	96
Microscopy .....	20	Redemption of rights of usage.....	32	Total sum of hours for secondary sciences .....	340
Botanical reviews.....	20	Forest history.....	40	Grand Total.....	2,648
Botanical excursions, each two and a-half hours.....	80	Forest statistics.....	20	Percentage of fundamental sciences .....	50
General zoology.....	16	Review of various forest matters .....	56	Percentage of principal sciences .....	37
Vertebrates.....	80	Examinations .....	40	Percentage of secondary sciences .....	13
Invertebrates, with special reference to forest insects.....	80	Forest excursions, each four hours .....	352		
Zoological preparations .....	16	Total.....	980		
Zoological reviews.....	20				
Zoological excursions, each three hours.....	96				
Total natural sciences.....	840				

NUMBER OF HOURS GIVEN TO THE DIFFERENT LECTURES—Continued.

Fundamental Sciences.	Principal Sciences.	Secondary Sciences.
Objects of instruction. Whole number of hours.	Objects of instruction. Whole number of hours.	Objects of instruction. Whole number of hours.
<p><b>MATHEMATICS.</b></p> <p>Geodesy ..... 72</p> <p>Interest and rent account..... 20</p> <p>Wood-measuring..... 20</p> <p>Mathematical reviews and exercises..... 56</p> <p>Surveying and leveling exercises, each four hours..... 192</p> <p>Plan-drawing exercises, two and a half hours..... 80</p> <p>Total mathematics. <u>440</u></p>		<p>Average per instruction week (21 in winter, 17 during summer):</p> $\frac{2648}{93} = 28.5 \text{ hours, or per day, } 4.9 \text{ hours.}$
<p><b>ECONOMICAL SCIENCES.</b></p> <p>Public economy and finances... <u>48</u></p>		
<p>Total sum of hours for fundamental sciences. <u>1,328</u></p>		

It may be interesting to learn through what phases the course of instruction has passed from the origin of this school to 1873. They have been as follows :—

*Number of hours devoted to instruction.*

Programme of subjects.	Two years' course.						Course of two years and a half.	
	1834—36.		1844—46.		1860—62.		1873—75.	
	Hours.	Per cent.	Hours.	Per cent.	Hours.	Per cent.	Hours.	Per cent.
Inorganic natural history .....	188	6	168	6	220	8	288	11
Botany .....	396	18	354	14	348	12	244	9
Zoology .....	326	15	332	18	332	11	308	12
Total natural history .....	910	39	854	38	900	31	840	32
Mathematical sciences .....	406	19	618	24	698	26	440	17
Economical sciences ..	54	2	36	1	36	1	48	1
Total for the fundamental sciences .....	1,370	60	1,508	63	1,634	58	1,328	50
Law, forest economy .....	814	38	904	30	992	35	980	37
Law .....	...	...	152	6	172	6	180	7
Forest construction.....	...	...	...	...	...	..	32	1
Hunting.....	40	2	40	1	40	1	32	1
Exercise with gun .....	..	...	...	...	...	...	96	4
Total for accessory instruction.....	40	2	192	7	212	7	340	13
General total.....	2,224	100	2,604	100	2,838	100	2,648	100
Time of teaching per day .....	4.8	...	4.8	...	6.2	...	4.8	...



‘ A fact is developed by this table, which is noticed in many other institutions, that the two years’ course had become crowded by the unavoidable development of new studies, so that before the enlargement to five semesters, the recitations and exercises occupied 6.2 hours each day, besides the time given to study. This requirement was too much, and could not fail, if continued, to bring lassitude and inattention. The course of law was introduced in 1844, and that of forest constructions in 1873. Professor Mathieu, of Nancy (from whose article in the *Revue des Eaux et Forêts*, 1874, p. 155, the above table is derived), remarks concerning the more recent addition of studies as follows :—

“ We would specify among other subjects recently added to the programme of studies at Newstadt-Eberswalde, microscopic examinations of vegetable tissues, and a general knowledge of the lower organisations, which, from their parasitic habits, are a determinate cause of a great number of maladies in plants and animals, and which are likewise agents in fermentation. Furthermore, we might specify the elements of organic chemistry, which are indispensable to an understanding of the laws of vegetable physiology; some ideas of forest statistics, one of the principal and most urgent of the desiderata of every well-ordered administration; a glance at the history of forests, and of the various phases through which the sciences relating to it have passed; and, finally, the elements of meteorology, which, by setting the forest agents to the pursuing of observations of this kind, will lead us to a certain knowledge of the influence still so controverted, as to the influence of the forests upon the climate of a country, and upon the delivery and maintenance of the sources of supply of the water which fertilizes it. All these new ideas are doubtless useful, and may, without difficulty, be included in our course of forest instruction.”

‘ Since 1872 the principal station for experiments relating to forest matters in Prussia, on which there is conferred, at the same time, the management of the

transactions of the Association for German Experimental Stations relating to forest matters, is connected with the Academy at Newstadt-Eberswalde in this way, that the latter's superintendent is also the director of the principal station, and that, under his direction, the instructors of the Academy are elaborating the different divisions of the experimental work, viz., the forest technical, the chemical, physical, the meteorological, the zoological observations, and also what relates to physiology of plants.

'This opens, on one hand, a large field of scientific researches to the teachers, putting at their disposal new teaching matter, and gives, on the other hand, to students the opportunity of studying how to prepare the scientific solution of interesting and important problems, and of taking their own share in the respective elaborations.

'The results of active instruction at this Academy during the forty-six years of its existence are highly satisfactory. Almost all the Prussian employées near the administration of public forests—without, however, counting those from the provinces added to Prussia in 1866, and who entered into Prussian service—owe their perfection in forest science to this Academy. Besides a considerable number of private forest officers and forest proprietors of the country have here acquired the necessary skill in administering their own forests or those committed to their charge. Finally, many foreigners have applied themselves at this Academy to the study of forest science. The following table, showing the annual number of students from 1830 to 1876, may be of service in judging of the Academy's operation :—

ATTENDANCE AT THE FOREST ACADEMY OF NEWSTADT-EBERSWALDE.

Years.	Semesters.		Years.	Semesters.		Years.	Semesters.		Years.	Semesters.	
	Summer	Winter		Summer	Winter		Summer	Winter		Summer	Winter
1830.....	39	36	1842.....	37	42	1854.....	84	84	1866.....	66	45
1831.....	30	29	1843.....	51	48	1855.....	83	76	1867.....	72	79
1832.....	23	23	1844.....	51	47	1856.....	62	65	1868.....	93	63
1833.....	28	21	1845.....	52	63	1857.....	57	64	1869.....	64	67
1834.....	36	30	1846.....	66	65	1858.....	72	67	1870.....	66	(a)
1835.....	36	29	1847.....	71	72	1859.....	68	54	1871.....	62	66
1836.....	36	32	1848.....	68	81	1860.....	44	51	1872.....	61	63
1837.....	33	32	1849.....	78	83	1861.....	53	55	1873.....	57	52
1838.....	40	41	1850.....	84	86	1862.....	47	38	1874.....	68	45
1839.....	45	40	1851.....	80	85	1863.....	33	32	1875.....	68	50
1840.....	40	34	1852.....	81	80	1864.....	36	42	1876.....	66	50
1841.....	40	45	1853.....	84	84	1865.....	57	59	Average....	57	54

(a) Closed on account of war,

It is stated from information a few years ago that there were not less than 33 barons or baronets who held appointments in the Crown Forests of Prussia.

The following details of the requirements for employment and promotion in the forest service in Prussia are given in the *Bestimmungen über Ausbildung und Prüfung für den Königlichen Staatsforstverwaltungsdienst*: Requirements for the education and examination of officials in the Prussian State Forest Service. The applicant to be received into the forest service must satisfy the following conditions issued by the Minister of Finance on 30th June, 1874, with some verbal changes subsequently ordered:—

1. 'He must have obtained a diploma of completed study in a gymnasium of the German Empire or in a *Realschule*. 2. Be not above twenty-two years of age. 3. Have no bodily infirmity which would unfit him for the forest service. 4. Be of good conduct. 5. Give proof of possessing sufficient means to meet the expense of preparation for the work.

'This preparation commences with practical work done in the forest, under the direction of an *Oberforster*, during at least seven months, generally from October to April.

'The design of these preliminary exercises is to make the aspirant acquainted with the work of exploitation, and with the principal kinds of trees, to make him practically acquainted with silviculture, with the surveillance of woods, and the police of the chase, and at the same time with land surveying, all of which are things which lie at the foundation of his subsequent theoretical studies.

'To be appointed *Forstbeflissener*, or forest-aspirant, an application must be made to the inspector, or to the conservator, of the administrative circuit; this application must be transmitted by the *Oberforster* to whom the pupil desires to be attached.

'The papers to be supplied are five in number. 1. The diploma of study from a gymnasium or *Realschule* of the first class. 2. Certificate of birth or baptism. 3. A medical certificate. 4. If the aspirant do not pass directly from the gymnasium to the service, a certificate of good conduct from the time of his leaving the gymnasium. 5.

An engagement by the father or guardian of the aspirant to provide for the maintenance of him during at least seven years.

‘Further, the *Oberforster* must supply special information, in regard to the family and person of the aspirant; and then if there be nothing to hinder the aspirant being accepted, he receives his appointment from the inspector or the conservator. These have a right reserved to appoint the aspirant to another *Oberforster* than the one he has chosen, and even to remove him during the time of his preparation, after having referred the matter to the Minister of Agriculture, Domains, and Forests.

‘If the aspirant on trial prove not quite satisfactory in the triple point of view, physical, intellectual, and moral, the *Oberforster* addresses a report to the inspector and to the conservator, who judge whether the aspirant should continue his studies; in case of a difference of opinion between them the minister decides.

‘This stage passed, the *Oberforster* delivers to the candidate a certificate testifying to the time spent in this stage, and to the work done. This certificate confers on the aspirant the title of forest pupil. To continue his studies the forest pupil should follow for at least two years and a-half the course of study of a School of Forestry, or of a Forest Institute annexed to a university; those who may desire to follow that pursued in another school than those of Eberswalde and Münden should previously assure themselves from the office of the minister that the time spent by them at this school shall be reckoned equivalent to the studies prescribed by the regulations; and further they are required to study all the subjects comprised in the programmes of these said schools.

‘These forestal studies completed, and, at latest within six years after the commencement of the preparation, the pupil addresses to the minister an application to be admitted to the examinations, and attaches to this the following papers:—1. A *curriculum vitae*, or history of his previous course of life, entirely in his own handwriting.

2. The diploma of study in a gymnasium or *Real-schule*.  
 3. The certificate of being a forest pupil. 4. The certificate of his having attended a School of Forestry or a University in the course of his studies 5. A certificate that the pupil has taken the required part in works of land surveying, and the preparation of charts, at the School of Forestry or at the University. 6. A chart prepared by the hand of the candidate, of some Royal forest of at least 500 hectares, on the scale of 1 to 5000, and this chart must be accompanied with an attestation that the work has been done entirely by the pupil.

‘The design of the examination is to make it be seen that the pupil possesses the general instruction required, and that he has made with success the technical studies prescribed; and to determine further that the pupil is fit to continue his studies.

‘The knowledge required at this examination are these:—

‘A.—In Special sciences.

‘Exploitation, management, and estimation of woods, technology, protection of the State forests, and forestal history and bibliography.

‘B.—In Auxiliary sciences.

‘1. Mathematics. Elementary principles of statics and mathematics. 2. Natural History.—Principles of the classification of animals, plants, and minerals. A. Zoology.—Divisions of the animal kingdom; mammalia, birds and insects looked at from a forestal point of view; entomological nomenclature, structure and habits of insects in general, and special study of those which are useless or hurtful to forests. B. Botany.—Classification, description, physiology, and structure of plants, and special knowledge of those which are useful from a forestal point of view. C. Mineralogy.—General notions of geognosy and geology; general idea of the formation and the upheaval of mountains; influence of the subsoil on vegetation, and special study of the minerals and rocks useful to the forester. D. Physics and Chemistry.—

General properties of bodies ; views entertained in regard to light, heat, magnetism, and electricity ; carbonisation, resin, and tannin.

‘ 3. Legislation and Jurisprudence.—History of Prussian law ; notions of civil and criminal law as applied to forests.

‘ The examination takes place in general once a year, in September or October, before a commission appointed by the Minister of Agriculture, Domains, and Forests. This examination is held, one part indoors, and another part in the forests ; if it prove satisfactory, the forest pupil receives the title of Forest Referendary.

‘ In case of failure he is allowed to recommence his trials, in whole or in part.

‘ To continue his preparation, the forest referendary should devote himself to personal studies in the forest, and, moreover, take an active part in all forest works, in order that he may acquire, under an *Oberforster*, all practical knowledge relating to forest economy and forest administration. In the first instance, he is free to choose the circuit in which he wishes to prosecute his studies ; but the Minister reserves the right to send him officially to any specified circuit.

‘ The *Oberforster*, near to whom the forest referendary is sent, is his immediate superior, and the referendary should take for his guidance in the service the instructions issued to forest overseers. The duration of this stage imposed on a forest referendary is at least two years. He should pass eight successive months, which should always comprise the interval between December and April, in discharging the duties of a forest guard in the same circuit, and in a particular part of the circuit. This part is chosen by the *Oberforster* according to the indications made by the inspector, and the candidate should give himself entirely to all the works of the guards engaging in the surveillance, as well as in the exploitations, preparation of estimates, measurement of trees, sales, and the cultural operations going on.

‘ During these eight months he cannot be employed in the office of the *Oberforster*.

‘ The referendary ought then to visit different circuits : the design of these visits being to make him familiarly acquainted with all the kinds of trees growing in the forest, to give him explicit conceptions of different modes of exploitation and management, and in fine, to give him practice in all kinds of forest business by making him take part in all the operations of an *Oberforster*.

‘ During this stage the referendary is required to keep a journal. This journal ought to indicate the circuits in which he has had a charge, their situation, their soil, and the exploitations and works of culture in which he has had to take part, &c.

‘ It ought, moreover, to contain notices of remarkable facts which have struck the referendary, and the observations which have been suggested to him by the study of the forest, and by the works which he has had to do in the office of the *Oberforster*.

‘ The journal should be sent to the *Oberforster* on the first of every month, and submitted to the superior agent in the circuit, if such there be.

‘ In fine, when the referendary leaves the circuit, the *Oberforster* should indicate the date of his departure, and give testimonials of his conduct. If there be occasion for observations in regard to faults, to want of punctuality and obedience on the part of the referendary, or especially if he has shown a real incapacity for the work of forest service, the *Oberforster* is bound to make his report of his to the inspector and to the conservator.

‘ The Minister of Agriculture and Forests can exclude from the service any forest referendary who may have manifested gross misconduct or negligence, or any candidate whose progress may be considered unsatisfactory.

‘ Every *Oberforster* ought to send to the inspector, at latest on 5th January in each year, a statement of his opinion of the candidates who have passed in the course



of the preceding year more than four weeks in the circuit. The inspector adds to this his own observations. When the candidate has discharged the duties of an overseer, the inspector should give the results of the examination which he has made of the district entrusted to the management of the referendary. These documents are sent by him to the General Directory before the 15th January; they are collated and compared with those furnished by the conservator, and are then sent to the Minister to form the file of papers relating to the candidate. When the referendary has completed his course, done all the prescribed works, and satisfied the requirements of the military service, he may address to the Minister an application to be allowed to pass the State examination; the time allowed for this is five years from the passing of the last examination.

‘To this application are attached the following papers: 1. A *curriculum vite*. 2. The diploma of study at a gymnasium. 3. The diploma of forest pupil. 4. The certificate of diligence in the course of a School of Forestry. 5. The journal. 6. Lastly, for candidates who belong neither to the corps of *feldjäger*, nor to the batallions of chasseurs, a document attesting that they have satisfied the military service.

‘When there is nothing to hinder authorisation being given, the person named is sent before a commission who inscribe it, and fix for him the date of his examination.

‘This examination is conducted according to the instructions and regulations of the minister, partly indoors, and partly in the forest. The latter is by far the more important, as it determines whether the referendary has acquired practice and knowledge of administrative questions.

‘The examination turns on all parts of forest science and of forest economy in their connection, on the application of special law and common law to forest matters, and on the police and administration of the chase.

‘The referendary having been subjected to this examination, at once receives from the commission the title of

Forst-Assessor, and is inscribed on the roll of officials going through their course of training.

‘If the referendary do not pass the examination with success the commission decides whether or not he shall recommence his trials in whole or in part after a delay of at least six months, but which must not exceed twenty-four months.

‘The Forst-Assessor is employed in the royal administration so far as is practical until he receives his appointment, and he is bound to apply himself to the forest works which the minister may entrust to him.

‘If the Forst-Assessor undertake the administration of communal forests, of public establishments, or even those of private persons, he ought to communicate this to the minister; and this undertaking is not in any way a reason for excluding him from the royal service; but it is clear that the years spent thus, are not to be reckoned to him as years spent in the service.

‘And in case a Forst-Assessor after a certain lapse of time passed thus beyond the royal service, should refuse a work which the administration would give to him, he may, on the proposition of the minister, be removed from the roll of officials going through their course of training.

‘Each Forst-Assessor is bound to make known, through the *Oberforster*, his presence to the inspector and to the conservator of the circuit in which he finds himself, and whether he belongs to the royal service, or he be administering private forests. Likewise on each change of residence he should make a similar communication to the same agents.

‘In order to acquire a more extended instruction, and perfect themselves in the general practice of business, aspirants to the forest service should, beyond their technical studies, go through a course of law and of political economy at a University. The candidate is free to make choice as to the time at which to pursue these studies, as that which may best suit him while prosecuting his preparation; but it is preferable that he should take them up while he is a Forst-Assessor.

The Forest-Assessors who, besides the ordinary prescribed forest studies, give themselves for at least two half-year sessions to the studies of these political sciences, can, after having been attached for one year to a Directory of Finance, address to the Minister an application for permission to submit to an examination on the matters spoken of; which application should be accompanied by a certificate of his having followed a course of study at a University. This examination is conducted before the superior commission of forests, by the Minister-adjunct of the special examiners for legislation and political sciences. It turns on the applications of civil law in Prussia to the administration of forests, and principally on the administration of law and political economy. But this is no longer required absolutely.

The trials ought to show whether the candidate possesses the knowledge necessary to enable him to discharge in a satisfactory manner the duties and functions of a *Member of a Forest Directory*. The Forest-Assessors who pass this trial successfully receive from the Minister the title of *Oberforster*. The inspectors, or *Först-meisters*, are chosen from among the *Oberforsters*, who must have distinguished themselves in their service, and preferentially from amongst those who have passed the last mentioned examination.

Captain Campbell Walker, formerly deputy-inspector of forests at Madras, writes of a visit paid by him to Newstadt-Eberswalde:—

‘I visited the Forest Academy at Newstadt-Eberswalde, and had a most interesting conversation with the Director, Herr Ober-forstmeister Danklemann, on various subjects connected with the forestry in Europe and India. He is assisted by a staff of seven professors, with assistants, and there is an Experimental Garden attached to the Academy, with Oberförster Bernhard in charge of the strictly technical portion, and other gentlemen for the meteorological, zoological, and chemical sections. The number of students

at the Academy averages 65. Oberforester Bernhard kindly accompanied me round the gardens, and pointed out everything of interest, including a building where the seed is dried and separated from the cones, known as a "*Sammendarre*," extensive seed beds of spruce and fir sown in parallel lines, with the help of boards specially adapted for the purpose, which insure regularity, and the seed being all the same depth; seed beds of willow, and treatment of the seedlings when transplanted; and examples of trees of every description for botanical study, including many of the rarer description for the more advanced students.

'Professor Dr Altum, the successor of the well-known entomologist Ratzeburg, author of a large work on insects destructive to trees and timber, accompanied me through the museum, which is rich in specimens of all sorts of birds, animals, and insects found in the forests, very neatly arranged in cases. Where the animal or insect does damage to trees, specimens of the branch, bark, leaf, root, or cone, in a healthy state, and after being attacked, are exhibited close to each, so that the student can see at a glance the nature of the damage, and connect it with the animal which causes it. Thus we have squirrels, rats, beavers, and mice, set up to represent nature, gnawing the barks, grubbing at the roots, &c., &c. Insects are shown in several stages of their existence, larvæ, chrysalis, caterpillar, moth, with their ramifications in the stem or branches of the tree. These, with specimen blocks of almost all descriptions of timber, form a most instructive and interesting collection, in which much time could be spent with advantage.

'Nothing struck me as more remarkable than the extent and varied nature of the studies required from the forest candidates or probationers in Prussia, and the number of years they are content to spend, first in studying, and then in waiting for an appointment. The would-be Oberforster, which is the lowest of what we would call the "gazetted appointments," must, after passing certain

terms at a Government school of the first class, spend a year with an Oberforster in a revier, and then pass an examination as forest pupil, after which there is a two years' course at a Forest Academy, and an examination in scientific forestry, land surveying, &c., on passing which the pupil becomes a "*Forstkandidat*;" then another two years' practical study, during at least nine months of which he must actually perform the duties of a forester, after which comes the final Government examination, on passing which he enters the grade of Oberforster-kandidat. The difference betwixt the two examinations is explained to be that the first tests the candidate's knowledge of theoretical forestry and cognate sciences, whilst the latter tests his ability to apply what he has learnt, and capability for employment as Oberforster and in the higher grades.

'After passing the final examination, the Oberforster-kandidat is employed as an assistant in the academies and control offices, in making forest surveys and working plans, and sometimes acting in charge of a revier, receiving certain daily or weekly allowances whilst so employed. After five or six years of this probation, he may look forward to being permanently appointed.

'Thus we have at least five years spent in study, and another five years spent in probation; the former without any pay, and the latter only with meagre allowances whilst actually employed, before the would-be first officer is installed; and the time is generally much longer. Yet so great is the desire for Government service, and particularly forest service, in Prussia, and indeed in Germany generally, that there is no lack of competitors.'

The impression made on my mind was similar. I was struck with the completeness of the collections in the several museums. The Aboretum, or Forest Garden, is extensive, but it appeared to me that no use was being made of it, beyond what could be made of one much less extensive. The walks and drives seemed to minister

greatly to the amenities of the town, which is much frequented in the summer months by families lodging there, but at other times resident in Berlin; and though utilised for the instruction of the students, this appeared to me to be done more because they were at command, than as necessary and requisite.

I made inquiry here, as I did also elsewhere, in regard to the design of giving instruction in rifle shooting, and in much beside relating to the chase; and the information I received in reply was similar to what I received elsewhere, which was substantially, that it was not without its use, which was explained; but that it was more as an accomplishment than as a necessary qualification for forest management that such instruction was given; and it had been observed that foresters who took an interest in hunting took more heartily to life in the forest, and felt less of the *ennui* and restlessness, and desire after city life, from which some others suffered.

There are connected with the Academy, besides the Forest of Eberswalde, three others, with a total area of 18,606 hectares, of which 17,148 are under wood. Of these of timber forest—

447	are of Oak.
2,272	Beech.
217	Alder and Birch.
13,721	Pine.
29	Fir.
220	Plantations.

Of coppice wood there are 242 hectares.

The ground is of Tertiary formation, Diluvium, and Alluvium. The contour of two is hilly and almost mountainous.

The garden illustrative of forest botany is 190 hectares in extent.

The Experimental Garden, illustrative of different methods of annual plant culture, which, is 484 hectares in extent, with upon an average two millions and a half of plants;

and in Chorin, one of the forests, there is an Aboretum of 8 hectares.

Connected with the Academy is one of the most important meteorological observatories in Germany.

The museum was founded by Dr J. T. C. Ratzeburg, at that time Professor of Naturwissenschaft in the Academy, a distinguished entomologist, and author of a valuable work entitled, *Die Waldverderber und ihre Fiende, oder Beschreibung und Abbildung der Schaedlichsten Forstinsecten und der uebrigen schaedlichen Waldtheire, &c.* It is rich in specimens of all sorts of quadrupeds, birds, and insects found in the forests, and when they are injurious to trees, there are specimens of branch, bark, leaf, root, and cone—both in a healthy state and in the injured condition, enabling students to see at once the effects, and the animal by which they were produced. Insects are shown in the several stages of their existence—larva, chrysalis, and moth—with the erosions produced by each on leaves, branches, stems, and bark of the trees infested by them.

From a report made by Dr J. A. Warden, a member of the Scientific Commission of the United States, to the International Exhibition at Vienna, in 1873, the Academy cost the State 12,500 thalers, or well nigh £2000 per annum.

There were issued by the Minister of Finance, under date of 5th April, 1875, a series of statutes for the regulation of students, and appended thereto regulations relative to their studies and regulations, relative to the use to be made of the library, museum, &c. Subsequently there was issued a programme of course of studies to be followed; and on 16th October, 1882, a supplementary notice in regard to the examinations, to which students were to be subjected on land surveying and mensuration. The latest regulations in regard to the preparation required for the forest service were issued in August, 1883.

The number of students at Eberswalde in the summer

session of 1885 was 140; and in the winter session 1885-86, 148, of whom in the former 46, and in the latter 47, were not studying with a view to entering the Prussian forest service.

The staff of teachers in actual service numbers 11, namely, along with the director, 10 professors or docenten, of whom 5, including 3 in charge of oberforsteries, and the director of technological experiments in the station for forestal experimental research, give instruction in forest science; one in chemistry, mineralogy, and geonogy; one in statics, one in botany, one in zoology, one in physics, and mathematics, and one in jurisprudence. All of whom are provided with the necessary assistants.

As forest districts for instruction and excursion, four oberforesteries of the Government circuit of Potsdam-bhiesenthal, Chorin, Eberswalde, and Freienwalde, are placed under the technical administration of the Director of the Academy.



## CHAPTER III.

### THE ROYAL FOREST ACADEMY AT MÜN DEN.

THE Royal Forest Academy at Münden in Hanover was inaugurated 27th April, 1868, under Dr Gustavus Heyer as Director, and was richly equipped by the Prussian Government when Hanover became connected with Prussia. Münden is situated at the confluence of the Werra and the Fulda, whose united waters here take the name of Weser, which is navigable from this point to the sea.

It is the site of an old castle or Schloss, built in 1566 by Duke Erith II., which was formerly a residence of the Guelphie ancestors of the Royal Family of England. It has now been used for a long time as a magazine. The scenery around the town is pleasing, and has been considered not unlike that of the vale of Llangollen in North Wales.

For some years British candidates for appointments in the forest service of India were allowed to pursue their preparatory studies here.

The educational arrangements, and the course of study and of training, are similar in all respects to those at the Forest Academy at Newstadt-Eberswalde in Prussia. In both they are in accordance with the regulations issued by the Minister of Finance, under date of 5th April, 1875, and 1st August, 1883; and the course of study is similar. Like that at Eberswalde, this is subject to the general supervision of the Minister of Finance.

By Dr N. J. C. Müller, Professor of Botany in the Academy, I was courteously supplied some years since with the following information:—It was first opened in 1868. The

fees are 150 marks a-year. The course of study embraces five semesters, or half-yearly sessions, three summer and two winter sessions. Aspirants for employment under the forest service are admitted only at Easter, students from other Schools of Forestry at Easter, on the Monday after Easter week, and at Michaelmas (15th October).

Students must not be above twenty-five years of age, and must hold a certificate of having passed the final examination at a gymnasium or *Real schule* of the first rank; testimony in regard to the previous seven months having been spent in forest work; testimony to his good behaviour and to his means of livelihood while prosecuting his studies being provided.

Of the students in the Academy on 31st December, 1881, there were—

Free students,	.	.	.	5
Paying half fees,	.	.	.	7
Paying whole fees,	.	.	.	69

In all paying students 76.

Of these there were—

Subjects whose parents were engaged in husbandry,	5
Do. engaged in other callings,	71
Foreigners,	0

The number of those who had been educated there since the organisation of the Academy were—

Subjects,	.	.	.	629
Foreigners,	.	.	.	23

The area of an Experimental Garden was 5 hectares; the grant from public funds, 57,440 marks.

The Director of the Academy gave instruction in forest science; besides whom there were five professors and assistants giving instruction in mathematics and land surveying, geology and mineralogy, chemistry and physics, forest exploitation and botany.

In the teaching of botany there were devoted four hours a week to the morphology, biology, and classification of plants; two hours a week to practice in the classification and the microscopic study of plants; and a course of

demonstration and microscopic studies, occupying in all ten or twelve hours in the session. There were botanical excursions of half-a-day weekly. Three hours weekly in the winter session were spent in the study of the structure and physiology of plants. One hour weekly in microscopic demonstrations. And one hour weekly in winter in *Repetitorium*, or examinations in botany.

The designation of the institute is 'The Royal Forest Academy.'

The attendance of students at the Academy from 1868 to 1876 had been :—

Years.	Summer semester.	Winter semester	Years.	Summer semester	Winter semester
1868.....	44	52	1874.....	113	86
1869.....	60	61	1875.....	106	61
1870.....	62	75	1876.....	78	
1871.....	64	78			
1872.....	81	.....	Average.....	78	70
1873.....	83	74			

I enquired what reasons were assigned for the maintenance of two forest institutes in Prussia—one here and the other at Newstadt-Eberswalde. The reasons stated to me seemed to centre themselves chiefly into considerations of convenience; but amongst others it was stated that in the one district the forests were in a great measure forests situated on *Tiefebene*, or plains of but slight elevation above the sea level, and in the other district the forest are in a great measure forests situated on mountain ranges; and some advantage was gained by special studies, appropriate to each, commanding special attention in the different schools.

An important element to be taken into account in judging of the appropriateness of scholastic arrangements for the study of forestry with the view to entering the

forest service of a State, is the number of men required for that service. The writer of an article on forest management in the *Edinburgh Review* [No. 290, p. 373] states that 'the staff for the administration of forests in Hanover consists of two branches, which may be described as preparatory and administrative. All preliminary arrangements on taking a piece of forest land into culture by the State are conducted by the *Einrichtungsbureau* or survey office. This consists of a *Verstand* or superintendent, draughtsmen, and clerks, who are generally practical foresters; and a staff of surveyors and valuers, who are generally candidates for the office of *Oberforester*, the third grade in the system of permanent administration. The surveyor surveys the whole tract of forest, and delineates, with the aid of the valuator, the blocks or subdivisions into which it is to be divided for permanent culture. A detailed plan is drawn up for the future management, pointing out the mode in which the successive periods are to be worked off, the roads which it will become necessary to make for transport, and the usual details of the condition of the forest. This plan, together with a complete code of rules, is handed over for the guidance of the permanent forest officers.

'The permanent administration consists of one *Forstdirector* and *Oberforstmeister*, who is also a counsellor; 20 *Forstmeisters*, in charge of circles or divisions, who form also a consultative council; 112 *Oberforsters* in charge of districts of about 17,000 acres each; 403 foresters; and 343 overseers and under-foresters, who watch the forests, and supervise the work executed by contract or by day labour. A cashier is attached to each over-forester, who receives and disburses all money in and from the forest cash chest, on the orders of the over-foresters. A perfect financial check is thus maintained under the control of the forest master. The duties of these officials are confined to superintendence. The over-foresters spend the greater part of their time in the forest supervising the actual operations. So regular and

efficient is the entire system that the state of each block of the forest is generally found to be in accordance with the programme laid down on the original working plan.'

To make more clear what is referred to in the last sentence, it may be necessary to bring forward a statement, by which are preceded, the statements made:— 'The aim of scientific forestry in its present most advanced state, is to convert the irregular growth of woodland district into what is called a *Geschloss Bestand*, or compact forest, divided into district blocks of trees of equal age. The usual *Umtrieb*, or rotation for beech, and *Hochwald*, or high forest, in Hanover, is 120 years. The forest is so divided that there shall be as nearly as possible six equal areas allotted to as many periods of twenty years' growth. Thus, one block will be full of trees not exceeding twenty years old; a second, of trees from twenty to forty years old, and so on. When a block arrives at the last period felling commences by a *Vorbereitung*, or preliminary clearing, which is little more than the ordinary thinning carried on from time to time in former periods. The beech in these woods only ripens its seed every third or fourth year. After the first seed year in the final period, a *Lichtenschlag*, or clearing for light, takes place, in order to afford light for the germination of young seedlings; the finest trees being left standing. When the ground is well covered with seedlings the old trees are felled, and carefully removed; and the block recommences growth. The tendency to a gradual removal of the old trees appears to be on the increase, so as to make the culture approach as nearly as possible to the natural growth of a wild forest.'

The twelve provinces of Prussia, several of which represent kingdoms, are divided into thirty *Regierungsbezirken*; and to each of these is appointed an *Oberforstmeister* to represent the forest department in the council of the local *Regierung*, or administration; the *Forstmeisters* number 108, each in charge of a division, with an

average area of 25,000 hectares; there are 706 *Oberforsters*, with charges averaging 3000 hectares in extent, to each of which is attached a *Forstrendant*, or collector of forest revenue, and there are 3,646 *Forsters*, or overseers, with ranges of from 500 to 1000 hectares, in the forest service of the country.

At the Academy the number of students in the summer session, 1885, was 57, and in the winter session, 1885-86, 41, of the former of whom there were 9, and of the latter 6, who were not Prussian subjects.

Of the staff of teachers, 11 in number, there were, besides the director, 10 professors: four for forest science, of whom three had the direction of oberforsteries; one for mathematics and physics, one for chemistry, mineralogy, and geonosy, one for statics, one for botany, one for zoology, one attending from the University of Goettingen for political economy and financial science, and likewise one for jurisprudence, all with the necessary assistants. The forest districts appropriated for instruction, and placed under the direction of the Director of the Academy were the oberforsteries of Cattenbühl (in the province of Hanover) and Gahrenberg of the Government circuit of Cassel.

## CHAPTER IV.

### THE GRAND DUCAL FOREST ACADEMY IN EISENACH.

MY return journey from Dresden, after my visit to Tharand, brought me through Leipsic, Gotha, and Eisenach.

At Eisenach, in the Grand Duchy of Saxe Weimar, there was established, in the first decade of the present century, a Forest Institute, or School of Forestry, which may claim to be considered the oldest existing institution of the kind in the world, though Tharand may justly claim to be considered the representative of the earlier school which was originated at Zillbach in 1795. Tharand only celebrated her own jubilee in 1866, while Eisenach, in the spring of 1880, celebrated, not her centenary indeed, but the close of the hundredth session of the institute.

In a memorial statement issued on the occasion by Dr Carl Frederick Augustus Grebe, the Director of the Institute, and Oberlandforstmeister of the Grand Duchy, it is stated :—

‘The origin of the School of Forestry at Eisenach dates from the first decade of the present century. Heinrich Cotta had previously established, as is known, a Forest Academy in Zillbach in the year 1795, and maintained it till he was called to Saxony in the year 1810. G. Koenig sought to supply what was thus withdrawn from the arrangements for training young foresters for the work in which they were called to engage. He had laid the foundation of his knowledge of forest science under the guidance of Cotta at Zillbach, in the years 1794-1796, and subsequently qualified himself fully for the work, partly by acting as assistant forester—under, amongst others, Oetelt in Ilmenau,—and partly by taking part in the

Prussian arrangements for forest management. He was, in 1805, as forester, appointed an official of the forest administration of Ruhla; and here he commenced the work of tuition in forestry by receiving young foresters into his house as students in forestry. To these he gave practical instruction in all matters pertaining to the management of forests; and in the winter months he gave to them oral discourses on the more important branches of forest science; and not only natives of the Grand Duchy, but many foreigners were received thus into his house as students. This was the origin of the Forest Institute of Eisenach.

'A more formal character was given to this instruction in 1813. Koenig solicited, through his official superiors, permission to organise and establish in Ruhla a Theoretic and Practical Institute of Forest Science; this was readily granted by Duke Carl Augustus on the 11th January, 1813, along with the additional permission to arrange for this use the spacious forest lodge of Rhula; and on the same occasion, under date of 5th January, 1813, Keonig was appointed *Oberforster*.\*

'In regard to the instruction given in the private School of Forestry opened by Koenig, detailed information is given in Koenig's first published work, *Anleitung zur Holtztaxation*, Gotha 1813.—Introduction to forest taxation, or estimate of the cubic measurement and probable annual production of wood in a forest. According to what is stated there, young candidates for employment in the forest service were gradually thoroughly instructed in everything relating to the management of forests and game. After this they were, in some special forest district, instructed in the practical application of what they had acquired. All which was so done as to prepare them

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\* A large granite block, erected as a memorial stone in the Glocckler district of the Ruhla Forest, bears on its southern side as an inscription: *In dem Jahren, 1809-1812, von L. V. G. (Louis Von Gross), A. V. H. (August Von Hopfgarten), L. V. H. (Ludwig Von Hopfgarten), H. H. (Heinrich Hopfmann), F. H. (Ferdinand Hagemann); and on the eastern side:—1813, Wurde Hier Gepflanzt fuer 1871.* But it is alleged that this is misleading, as a private forest educational institute was organised and established by Koenig in 1808.



efficiently for the work to which they aspired. Within doors, and more especially in winter, from three to four hours daily were spent in theoretic instruction, with a view to the practical application which was to be made of this, the greatest importance being attached to mathematics. Information as to what was done from this time onward is not at command; but it is known that after the establishment of the Grand Ducal Forest Taxation Commission, in the year 1831 (with the direction of which Koenig was entrusted, he having been meanwhile, on 27th April, 1819, appointed Forstrath, or Forest Counsellor). theoretical instruction was given only in the winter half-year, and the students belonging to the Grand Duchy found their principal employment in surveying and making measurements, and in the preliminary work required for the taxation and management of the forests of the Grand Duchy.

‘In the year 1819 the Grand Duke Carl Augustus entertained an idea of establishing, in the Grand Duchy, instead of this private School of Forestry of Koenig, an independent State School of Forestry. Koenig having been applied to to supply information in regard to what would be required, submitted a detailed plan for such an institution; but, for financial reasons apparently, the measure was not carried into effect. We must forego the satisfaction we might have promised ourselves from considering minutely the interesting proposals of Koenig, but we may remark that Koenig at that time, in regard to the question of a site for the projected State institution (for which Ruhla, Berka, Ilm, and Eisenach, had been named), pronounced decidedly in favour of Eisenach; and this he did without hesitation or qualification; before everything else he desired for candidates for the forest service a superior general preparatory instruction, and for forest officials an improved social position.

‘Immediately on the accession to power of the late Grand Duke Carl Frederick, in January, 1828, he required of Forstrath Koenig to draw up a scheme of instruction

appropriate for a Forest Institute in Eisenach ; and there was submitted by him a detailed scheme of instruction on the 1st November following.'

Dr Grebe gives a detailed outline of the programme proposed by Koenig, and he goes on to remark :—' All that Koenig asked from the State, beyond the building, was an annual grant of 100 thalers, and that principally as a means of procuring such teaching appliances as books and instruments, and collections of natural objects. The scheme commanded high approval, expressed in a ministerial order of 4th July, 1829, which was issued with the following specifications :—

'1. The Forest Institute of Forstrath Koenig to be erected at Eisenach is, and continues to be, a State-supported private enterprise.

'2. The support afforded by the State shall consist :  
 (a) In permission to make use for purposes of instruction in the Institute of the staff of instructors employed by the Forest taxation commission. (b) In granting a building suitable for the purposes of the institution, or the means of hiring such. (c) In an annual cash payment of 100 thalers. (d) The use as training forest of the Grand Ducal Forests of Eisenach, Wilhelmsthal, and Ruhla ; and it is granted to Forstrath Koenig, in the interests of instruction, to have the control of the management of these forests. Attention shall also be given in the appointment of forest officials, especially in Eisenach, to select officials apt and qualified to teach. (e) The Forest Institute shall have the use of the botanical grounds, in the Karthausgarten, at Eisenach and Wilhelmsthal, for purposes of instruction in forest botany.

'3. Persons engaging in the forest and game services of the Grand Dukedom must have attended the Forest School at least one year ; and can neither enter the Jäger-corps nor otherwise be employed in the forest service, if they have not left the School of Forestry with a good certificate.

' At the same time there was required the preparation by Koenig of regulations relative to the preparation which

should precede admission into the Grand Ducal Forest Service, more particularly in regard to the instruction of candidates, and more especially their instruction in forest science; regulations in regard to the admission of students to the School of Forestry, and their leaving it; and regulations in regard to the practical training of candidates for employment in the service.\*

'On the basis of this arrangement, Koenig, after having procured a house of his own in Eisenach (Schmelzerstrasse No. 14), opened the Forest Institute at Easter 1830, in accordance with the approved programme submitted by him, and continued till his death, 22nd October, 1849, he having meanwhile been, on the 15th August, 1837, appointed Oberforstrath.'

During the winter session following his death, the direction of the Institute was entrusted to the oldest of the teachers, Sculrathjobst, and in Easter 1850, it was undertaken by Dr Grebe, the present director, who was recalled from Griefswald to undertake, along with the direction of the Grand Ducal Forest Taxation Commission, the direction of the *Forstlehranstalt*, which was at the same time transferred to the more spacious Grand Ducal building, Frauenberg.

Details of the educational arrangements and appliances of the Institute are given. The branches of forest science in which instruction was required to be given, in the most thorough manner and to the fullest extent, are these:—

1. Introduction to the study of forest science, with a glance at existing Schools of Forestry. 2. History of forests: a condensed survey of the chronological development of forest property, of forest economy, of forest science, and of forest literature. 3. Forest culture in the most comprehensive application of the term, with Stumpf's *Lehrbuch des Waldbaues* as a text book, but with extensive supple-

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\* The regulations submitted by Koenig were approved by the supreme authority, and published on the 16th February under the title *Vorschrift Wegen Bildung der Bewerber um Forstdienststellen im Grossherzogthum Sachsen-Weimar-Eisenach*, Proposals in regard to the education and training of candidates for the Forest Service in the Grand Duchy of Saxe-Weimar-Eisenach; and they continued to be acted on till the subsequent issue under date of 6th February, 1854, of the Order of which is now in force.

mentary information. 4. Forest protection and forest management, with *Koenig und Grebe's Waldschutz und Waldpflege* as a text book. 5. Forest exploitation, with *Koenig und Grebe's Forstbenutzung* as a text book. 6. Forest management and regulation of amount of produce to be withdrawn from the forest. (a) Preliminary work: Forest surveys and measurement; description of the site and condition of the wood; with statement of the cubical measurement of the existing wood, and of the probable annual production by growth. (b) Basis of management: Selection of kind of wood and of *regime* to be followed—that of coppice wood, timber forest, or combination of the two; determination of duration of cycle of operations to be followed; the renovation of the forest and subsequent culture to be followed. (c) Method of exploitation; partition of the forest into divisions for successive fellings; application of these to the *fachwerksmethode* of exploitation with the maintenance of forests in good condition; and preparation of plans of operation. (d) Determination of produce to be obtained and of the utilization of the remainder. (e) Securing of sustained produce; bookkeeping and revision of programmes of successive operations in subsequent years. As the basis of instruction under this last head there are used *Koenig's Forst Mathematik* and *Grebe's Betriebs-und Ertragsregulierung der Forsten*. 7. Estimation of the value of the forest, with a special reference to financial operations, to sales, exchanges, expropriation and the determination of compensation to be given and required for damage done with *Koenig's Forst Mathematik* as a text book, with supplementary additions. 8. Forest economy in its application to State forests; general principles based on political economy, financial and police science, the relative importance of forests in national and State economy; forests in relation to different industries; the area and distribution of forests, local and general; deficient and excessive supply of forest products; what sites are most favourable for the practice of forest economy; what measure

of State control or of interference with all forests, so far as to secure their conservation and the advancement of forest culture, by the abolishing of servitudes and other hindrances to this, and the advancing of the required pecuniary means, &c., is expedient; and, what are the principles upon which a Government should proceed in the administration and management of State forests what superintendence a State should exercise over forests belonging to communes, to endowments, and to private parties; the training of forest officials, &c. 9. Organisation of the forest service, and documentary correspondence relating thereto. Instruction is also given in regard to the method of conducting judicial proceedings and office or counting-house work.

'The scientific studies embrace mathematics in the several departments applicable to forestry; natural philosophy, including inorganic, organic, and agricultural chemistry; mineralogy and elements of geology; physics and meteorology; botany in several departments, and agriculture; zoology, with special attention being given to entomology; forestry in all its departments; and jurisprudence.

'The full course of study extends over two years. The studies are so arranged that in resuming in one session the study of any science begun in the preceding session—by a review of the more important principles, and by retrospective questions relative to what has been previously studied, and more especially by examinations on the practical application, which may have been made, of what has been taught—the student can, at the commencement of each session, resume his studies without any fear of interruption to his course of study. The means employed in communicating instruction are: Lectures on the several subjects of study, examinations, practical applications of what has been acquired, and excursions.

'1. Lectures.—The living voice is found in practice to be the most stimulating and most efficient medium of communicating instruction. Free delivery of lectures,

founded on the statements made in appropriate text books, is the method of teaching which is generally adopted, and only in so far as the text book may require, some supplementary statement is recourse had to dictation. The lectures on the different subjects of study are given in the forenoon, in the hours from 7 to 9 and from 10 to 12.

'The subjects are so arranged that of the twenty-four hours weekly thus occupied, upon an average from nine to ten hours are devoted to forestry ; from seven to eight hours to physical science ; from five to six to mathematics ; and about two hours to training in judicial procedure.

2. Examinations.—These have proved to be a means of instruction no less efficient, in as much as they, when properly conducted, reveal what deficiencies in the instruction given require to be supplied, give opportunities for more ample explanation or illustration of difficult subjects, assist greatly the weak, and prove to all a wonderful stimulus to the prosecution of studies. To examinations on each of the subjects of study there is devoted at least one hour a week ; and towards the close of each session usually several hours a week are spent in examinations on different subjects.

'3. To practical applications and excursions are devoted, without exception, every afternoon after two o'clock.

'(a) Summer Session.—In the summer session either three or four afternoons in every week are devoted to exercises in surveying, that expertness may be acquired in the handling and use of the instruments, and an acquaintance with the different methods of measuring extensive plains, and limited patches, of taking levels, and altitudes, &c. In favourable weather the results to be obtained are wrought out in the class-room by logarithms, and trigonometrical calculations, and the preparation of charts and diagrams.

'(b) One afternoon in the week is devoted exclusively to forest excursions ; the first of these is employed in a general survey of the conditions of the ground, and of

the forest trees, &c., in the wood appropriated to the instruction of the students; in succeeding excursions each is devoted to the detailed study of some one object. And it is sought so to arrange these that the excursions shall be subservient to the instruction of the students by sight, such, for example, as the forestal peculiarities of different kinds of trees; the different ways of managing forests; the determining of sites for fellings, clearings, and thinnings, seed beds, and nurseries; different methods of culture; the measurement of trees, and estimation of their increase by growth; forest road-making, &c., combining, as much as possible, theoretical and practical instruction, that these may go hand-in-hand together. And in order to every facility being given for this mode of instruction, to the Director is committed the unlimited direction and control of the forest production of the forests assigned to the school for purposes of instruction.

‘ Besides the regular afternoon excursions, there are also made regularly occasional longer excursions into the neighbouring forest districts, partly to see the forestal peculiarities of the different forest sites—gneiss, mica slate, and porphyry, in the Ruhla forest; sechstein, variegated sandstone, and basalt, in the Markfuhl forest; mussel chalk, lias, and keuper, in the Kreuzburg forest, &c.—partly to obtain illustrations of those forms of management which are not to be seen in the forests in the vicinity of Eisenach, such as low coppice, medium coppice, conversion of medium of mixed coppice in timber forests, second growth of timber forests, the management of mountain firs, &c., with the different devices practised in the conducting of successive fellings, &c.

‘ (c) Moreover, there is in every summer session a complete regulation management, for an appropriated portion of Eisenach forest, gone through with all the preparatory work, exclusive of measurings, which would consume a great deal of time; and, in this simple work, the peculiarities of the different methods of taxation and management are illustrated. This work serves, moreover,

as the basis of a detailed example of estimating the value of a forest. While these more extended practical trainings are going on, lectures are entirely suspended.

‘(d) On one afternoon weekly, during the summer session, there is an excursion for the study of natural history, more particularly of botany and geology, for which the vicinity of Eisenach, with its manifold rare geological formations, and its corresponding rich flora, presents an excellent instruction ground. On the conclusion of these natural history excursions, every summer session there is carried out an excursion extending over some days, into the geologically interesting parts of the Thuringian forest, under the guidance of the teachers in this department of study.

‘(e) In the winter session there are, on every second afternoon, exercises in mathematics, repetitions, or examinations, forestal calculations, geometrical problems, &c., for practice, for assistance to the weak, and for the completing of the course of instruction of any who have not entered the school at the commencement of the course. Two other afternoons are set aside for practice in chart drawing. The excursions in the forests are confined to visiting fellings which are being carried on, in order to have here practical illustrations of some of the more important operations connected with fellings, such as the act of felling, trimming, preparing, and measuring logs, &c.’

Dr Grebe says ‘the systematic illustration and extension of theoretic instruction, by direct inspection and practice, we consider, after well nigh forty years experience, to be by far the most efficient and profitable mode of instruction, and one which cannot be compensated by any other method of instruction which may be adopted in a School of Forestry. The possibility of making available, for purposes of instruction, the various incidents occurring constantly in the management of a forest, such as the annual preparation of schemes of exploitation and of culture, the determination of sites of fellings, of thinnings, and of preparatory clearings. The work connected with seed beds and nurseries,



sowings and plantings, and the preparation of inventories, and estimates of the cubic measurement of wood in a forest, and of the probable annual increase, by properly qualified agents, for the administration and management, the conservation, exploitation, improvement, and extension of existing forests.'

The experience of Dr Grebe, to which he appeals, shows what advantage may be found in having forest operations daily under review by students; and of having every facility for taking immediate advantage of incidents as they may occur in connection with the management of a forest attached to a school. But it may be found that others, either losing sight of these, or in full view of these, consider that the advantages derivable from having a School of Forestry in connection with a University, or some other site of learning, more than counter-balance the advantage of having an independent site for such an institute: seeing that facilities can otherwise be obtained for the study and practice of the application of the instruction received in school. And, without prejudice to the statement made by Dr Grebe, it may appear that others, with like facilities to those enjoyed by him, have attached more importance to other arrangements for securing the same advantage to students. My sympathies are with these; but I consider it a good preparation for entering upon the account to be given of the discussions which have taken place on this point, for the reader to give its full weight to this testimony by Dr Grebe.

Growth, descriptions of the contents of the forest, and all the work in a model forest required to secure the continuous uninterrupted work which has to be done, can, he alleges, only be secured in an independent institute—and never in the complex system of education carried on in a University. A circumstance, this he adds, of great weight, which has been too much overlooked in the controversy which has been going on for some time in regard to the proper site for a School of Forestry.

We are about to enter on the consideration of the controversy to which Dr Grebe refers. His allusions to it burst upon us like the boom of the first cannon fired at dawn of a day of renewed strife in the assault and defence of some fortress, upon the scene of which we have come overnight, and we shall soon be looking upon the contending foes in the thick of the battle; each party and each combatant contending for what he believes to be the just, the true, and the best—the best for all, and best for the interests of Europe and of the world; in so far as these may be involved in preparation for work.

The most important and most extensively used means of instruction in the Eisenach institution, are the forests attached to it; and next to these, among such means may be reckoned the library and the museums.

‘1 What is reckoned here an indispensable appendix to a School of Forestry is a forest for field instruction. Here there are, in the first line, the Grand Ducal *forest reviers* or districts of Eisenach, Wilhelmsthal, and Ruhla; and more distant, but still adjacent, being upon an average within range of a day’s tour, the forest districts Marksuhl, Frauensee and Kreuzburg, in the Grand Ducal forest.

‘The first-mentioned comprise an aggregate circuit of 61,146 hectares; and extends partly over existing members of primitive rocks—granite, gneiss, mica slate, porphyry, &c.—partly, and that for the greater part over the red clay, and lastly, partly on the borders, over different members of the Sechstein formation, with an unusually varied and complicated earthy covering. The second class of forests named, presents, on the other hand, in Marksuhl and Frauensee, different localities of coloured sandstone, with basaltic eruptions of Muschelkalks in Kreuzburg, and of Keupers and Lias. With the exception of the latest formation, there are also within reach of a day’s excursion represented all formations providing a field full of instruction in geology, rural economy, and more especially in forest economy, such as is hardly to be found combined anywhere besides.

‘These diversified conditions present for botanical study a very rich flora; and, above all, a very varied condition of forest existence. The higher lying parts of the Ruhla forests have quite a mountain character, with a preponderating covering of coniferæ, and supply an opportunity of studying the characteristic of this kind of wood; the phenomena of windfalls, and injuries done by frost and snow; the felling of such, and the manifold devices used for the protection of forests against such calamities; and the regulation of the succession of fellings practised. In the forests of Eisenach and Wilhelmsthal there predominate timber forests of beech. These supply, in great variety, illustrations of the felling of timber, with provision for the natural reproduction of the forest; and therewith are found illustrations of the process of converting broad leaved forests into forests of coniferæ; also, of the measures taken to promote the growth of seedlings and saplings, by the destruction of injurious weeds, and by successive thinnings. And again, altogether different is the tree growth and the treatment of this on the coloured sand stone of the Marksuhl forest, and on the Muschelkalk of the Kreuzburg forest: in the first of these are located the seed beds and nurseries, while in the latter are very instructive representations of the middle timber forest, and of the conversion of such into timber forests, and of the treatment of mixed timber and coppice woods.

‘2. The library of the institution has a tolerably complete collection of all works treating of forestry, and of the more important works treating of mathematics, natural history, and political economy. It comprises, for example, about 2100 independent writings; and a considerable portion of the grant from Government is spent on the maintenance and increase of the library. The use of the library is, as may be understood, open to the students under prescribed rules.

' 3. In the museum are provided collections of different kinds: (a) A pretty complete collection of all mathematical and metrical implements in use in forest economy; the latter, for example, comprising several specimens of each for use in practical instruction in surveying, for training in which the students are divided into sections. (b) A pretty complete collection of implements and of models, especially of such as pertain to the culture of seedlings and trees, the transport of wood, the economic use or sale of wood, and the improvement of forest products—including models of buildings, bridges, and sluices, of appliances for the procuring of secondary products, charcoal-kilns and kilns for the manufacture of pitch, tar, lamp-black, &c. (c) An instructive mineral and geological collection. (d) A rich herbarium, comprising the more important kinds of exotic woods; a collection of models of the more important fungi—Her Royal Highness the Grand Duchess of Saxony having presented to the institution a valuable collection of the same, known as "The Arnold Collection of Models;" and collections of seeds and of different kinds of wood. (e) A collection of the more important insects, and specimens of their destructive work.

' But the collections of objects of natural history, through limitation of space and of funds, are somewhat limited, and cannot be compared with those in some of the larger forest academies. They are confined to what are deemed absolutely indispensable for purposes of instruction, and they only suffice for this through the richness of the surrounding country in geological and botanical specimens.'

With regard to the expense of maintaining the institution, it is stated that, according to an arrangement in the finance department of the Ministry of the State of the Grand Duchy, there is given to the institute only an auxiliary pecuniary contribution. This has been for the twenty years—1830-1849—5593·37 marks, a yearly average of 280 marks; for the thirty years—1850-1879—

50228·29 marks, averaging 1668 marks a year; for the fifty years—1830-1879—55821·66 marks, on an average 1116 marks a year.\*

These contributions are used mainly in aid of salaries paid to individual teachers, and the maintainance of educational appliances, namely, the library and collections of objects—on the latter, for example, have been expended, since 1850, not less than 17,541 marks or about thirty-five per cent of the whole. But in connection with this it should be borne in mind that the Director of the institution is at the same time president, and the teacher of mathematics is a member of the Grand Ducal Forest Taxation Commission, and the payment of the salary of the former has been entirely, and that of the latter to a great extent, taken over by that court; and about half of what is thus paid may be considered expenditure on the institution.

The conditions on which students are received into the institution vary according as they may be aspirants for employment in the State Forest Service of the Thuringian States—those in the Grand Duchy of Saxe-Coburg Gotha, in the Duchies of Saxe-Meinigen, &c., and in the principality Swarzburg-Rudolstadt, and Saxe-Sondershausen—or aspirants from other countries—or, lastly, are received as hospitanten.

According to existing arrangements, there are two instructors in forest science; the director, who is first teacher in this department, and a teacher of mathematics; two of natural science; one assistant as a teacher of political economy. There is required of students at admission the exit certificate of a gymnasium or of a *real-gymnasium*, and one year's preparatory study. The course embraces two years; but aspirants are free to attend some other

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\* In this last amount are included contributions which were made from State funds on the occasion of the Congress of the foresters of Thuringia being held in Eisenach in 1858, and of the Congress of the foresters of Germany being held in Eisenach in 1876.

School of Forestry. Annually, at the close of the winter session, there is held a *Tentamen*, which extends to all the branches of instruction in forestry. Special stress is laid on mathematics, but without including the higher departments of that science. As forests appropriated to instruction, there are, as has been stated, the six forest *reviers* or districts of the Eisenach inspection, with which the Director is entrusted.

The number of students in the summer session of 1885 was 168; in the winter session of 1885-86, 71; of whom, respectively, 12 and 13 were from the Thuringian States.

The institution founded by Koenig in 1808 at Ruhla was originally a private enterprise, and such it remained till 1830, when it became a State establishment; and such it has remained.

Eisenach is the site of the palace of the Grand Duke of Saxe Weimar, and here, in the Wartzburg, Luther was imprisoned. A relict of his imprisonment is shown to travellers, in a black smutch upon the wall of his cell—produced, it is said, by the ink in the inkstand, thrown at the head of an apparition considered by him to be the devil.

We are here in the centre of a forest region, to the north-east are the Hartz mountains, also associated with tales of diablery, and covered with the remains of the Thuringian forest; while to the south stretch away successive vestiges of the Black Forest, scarce less interesting to the worshipper of ancient remains.

A guide book well known to travellers tells:—

‘The Thuringian Forests.—The Thuringarwald is a hilly, wooded tract of country, extending from the sources of the Werra, north-west to near Eisenach. It is a part of the ancient Hircynian forest, and is about 70 miles long, and a breadth varying from 9 to 16 miles. It is thinly peopled; but it is rich in metals, particularly iron and cobalt. Its highest peaks range from 2000 feet to 3200 feet. It is covered with fruits in almost every direction.

It is traversed by only two great roads. It gives rise to a number of streams which flow into the adjacent plain, and eventually into the Main, the Weser, and the Elbe.'

By proceeding from Eisenach to Frankford an opportunity of visiting several outlying portions of the Thuringian forest may be had. From Gotha the Hartz mountains may easily be reached. This was my route on the occasion of a previous visit to Eisenach.

Shortly before crossing the boundary of Hesse Cassel, in travelling to Giessen, the traveller passes through Marburg, a town on the Lahu, built on the slopes of a hillside, and the site of the first university founded in Germany after the Reformation. It was founded in 1527. It has, or had, forty professors, but not a proportionate number of students.

On the Schlossberg rises proudly the ancient *Castle of the Landgraves of Hesse*, a structure of the chivalrous ages, now dismantled, commanding a fine prospect.

The houses inhabited by Luther and Zwingli during the theological discussions which they carried on in the presence of the Landgraves of Hesse, still exist; but it is Giessen which is now our destination.

## CHAPTER V.

### FORESTAL INSTRUCTION AT GIESSEN IN HESSE-DARMSTADT.

THE several Forest Academies which have been brought under our consideration, thus far are all of them properly designated Forest Academies. They are technical institutions, designed exclusively for instruction in forestry, and fulfilling for a time, and that a long time, that function alone. The study of rural economy was prosecuted in the same institution as the study of forestry in the Saxon Academy at Tharand ; but, since 1870, it has not been so. At Giessen there was formerly such an institution, but it has been combined with the University which is there—a University well known by name at least in Britain, as the seat of learning in which Liebig and his disciples pursued their researches in agricultural chemistry, with great benefit to the nations. And then there is brought before us another phase of Schools of Forestry.

With regard to the School of Forestry in Giessen, as with regard to that at Eisenach, I have to state that I had only one evening, or rather part of an evening, and the early morning of the following day to spare for seeing the interesting town in which it is situated ; and beyond seeing the locality, I could not, by personal observation, or enquiry at the honoured officials entrusted with the instruction of students, make myself acquainted with the existing arrangements in connection with this ; but what I thus missed learning on the spot, was subsequently supplied by correspondence with Dr Hess, the professor of forestry in the University, and by published and official information supplied to me by him,



Giessen may boast of being the site of one of the original Schools of Forestry, established a hundred years ago, inasmuch as from 1795 till 1825, forestry appear to have been taught in the University as a branch of the instruction given in the study of political economy.

From the introduction to a pamphlet, written by Dr Hess, on the organisation at present existing for the study of forest science in the Ludwig University of the Grand Duchy of Hesse, in Giessen, published in 1877, it appears that the School of Forestry of Giessen was first established as a distinct institution, by Ordinance dated 24th March, 1825. The first director was Dr Johann Christian Hundeshagen, to whom was given the titular rank of Oberforstrath, and who held the appointment of ordinary professor in the University. Dr Hundeshagen had, from 1818 to 1821, laboured in Tübingen as Professor of State-Forest Management; in 1821 he was called to the office of Director of the *Forst-Lehr-Austalt* of the Electoral Principality of Hesse at Hersfeld, whence he was called, and transported to Giessen by Decree of 19th May, 1824. By Decree of 24th March, 1824, Carl Heyer, then *Revierforster* at Greinberg, was nominated provisionally as second teacher in the institute. Dr Hundeshagen announced two courses of lectures, and one *Examinatorium* in the winter session 1824-25, but whether these were actually held does not appear from the records. The records preserve also both a manuscript and a printed list of lectures, for the summer session of 1825. But after giving the prescribed notice, the proposal to lecture on forest science came to nothing, and he delivered only his course of lectures on rural economy (*Lande-wirtschaft und Lande-wirtschaftlische Polize.*) And in the winter session, 1825-26, the course of lectures on forest science had the same fate. In the course of these three sessions there only appeared as students one Hessian, Gustav Hoffmann, from Büdingen, and two foreigners.

It was not till the summer session of 1826 that the

lectures on forestry were fairly established. In this session Dr Hundeshagen lectured on *Forst Benutzung* or exploitation, and *Forst-Schutz* or conservation; and Carl Heyer gave instruction in forest botany and *Waldban*. The latter appeared in the class-room only occasionally, while he gave himself mainly to his functions as *Revierforster* in the town forests of Giessen and other communal forests; and to him, on this account, it was generally given to go on excursions with the students, and to give to them practical instruction in the forest. These seem to have been first entered on in the summer session of 1827, when ten new students enrolled themselves. Here many students of previous years still remained. What number of students attended during any one of the earlier sessions does not appear from the records.

By Decree, bearing the date of 20th September, 1827, Dr Johann Ludwig, Klauprecht, who had previously taught forest science, mathematics, and forest natural history in Asschaffenburg—the Forest Academy of Bavaria—was licensed or installed as *Privat-Dozent*, or college tutor in Giessen, more especially for forest science; and he began his lectures in the winter session of 1827-28.

The relative duties of the two recognised teachers in the forest institute, Hundeshagen and Heyer, was further regulated by instructions issued 17th November, 1830, and the curriculum was fixed as comprising three sessions. As subjects of lectures, besides practical instruction to be given by them, there were prescribed *Forstans Iattungskunde*, or instruction regarding the duration of continuous supplies to be expected from forests in a given condition, together with forest botany, *Waldban* or Sylviculture, and *Forst-Schutz*, or forest conservation. Meanwhile Heyer had been promoted by Decree of 28th December, 1829, to be forest inspector at Giessen, together with his appointment of second teacher in the institute. But shortly thereafter, in consequence of various misunderstandings between the two teachers, by Decree of 12th April, 1831,

he was released from both appointments that he might enter on the office of *Forst-Meister* in the service of Graff-von Erbach-Fürstenau. And on his own application, Hundeshagen was, by Decree of 14th June, 1831, relieved of the direction of the forest institute, and it was arranged that the teachers and students of forest science should stand in every way in the same position and relation as teachers and students in the other departments in the State University.

‘By this measure,’ says Dr Hess, ‘the Forest Institute, which had existed for a few years as a distinct establishment associated with the High School, was elevated in every way; and instruction in forestry became completely incorporated with the instruction given in the University. This arrangement continued unchanged; and the terms *Forstinstitut* and *Director des Forstinstitut*, when they are used, have a reference only to internal arrangements. He writes:—

‘The *Forstgarten* of the *Institut*, which was transferred to the University at this time, continued to require and to receive appropriate management and superintendence as an important means of instruction; and the forest museum, or collections of products, implements, &c., must be maintained and increased. There are many grants for these purposes to be expended. The sums expended for the utilisation of the arts to instruction, for the annual outlay on the management of the Aboretum, for the engagement of labourers, and assistance when required in the practical services and the excursions, &c., must be regularly calculated and accounted for, and there is much correspondence necessarily connected with all of these matters. These business arrangements are laid upon the first teacher for the time being, and are attended to by him as Director of the Academy Administration Commission. But the term Forest Institute and the Director of the Forest Institute have nothing to do with the instruction in forestry which is given.’

Such are the statements of Dr Hess in regard to the historical development of the Giessen School of

Forestry, and he goes on to state that Dr Hundeshagen, after ceasing to be director of the institute, confined himself to the duties of his professorship of forest science. Oberforster Dr August von Klipstein stepped into the place of Dr Carl Meyer, and by Decree of 12th November, 1831, he was nominated as second teacher of practical forest science in the University of the State, which position he held till 1836, when, by Decree of 31st October, he was appointed Ordinary Professor of Mineralogy in the State University.

Dr Klauprecht, who, in connection with Hundeshagen, had continued to give instruction in Forestry, was, by Decree of 5th June, 1832, nominated Extraordinary Professor of Forest and Political Economy; but by Decree of 20th November, 1834, he was released from this that he might be free to accept a call to the Polytechnicum at Carlsruhe, which had been given to him.

In the same year, on the 10th February, Hundeshagen died, in the 51st year of his life; greatly honoured by his associates in the University for his profound learning, the more commendable that his life was somewhat embittered by nervous irritability arising from disease; and the loss sustained by the University through his death, was deeply felt.

He was succeeded as Professor of Forest Science by his former associate—Dr Carl Heyer. With him was associated Dr Carl Zimmer; and he attended mainly to the theoretical, while the latter attended mainly to the practical departments of their subject. Finding himself unable to attend to his own satisfaction to his duties as professor, and to those of forest inspector, to which he had been appointed with the rank of *Forstmeister*, he got assistance in the discharge of the latter duties; and subsequently his son, Dr Gustav Heyer, became successively lecturer and successor of Dr Zimmer in his professorship when he died, and after the death of his father, Professor of Philosophy, and Extraordinary Professor of Forest Science.

With him was associated Dr Edward Heyer as second teacher of forest science, till, in 1868, Dr Gustav Heyer was called to the newly-established Royal Prussian Forest Academy at Münden.

This led to the appointment of Dr Hess, who, in the discharge of his duties, found that the assistance given by a teacher holding an official appointment as a State forester was productive of serious inconvenience, arising in part from the circumstance that the University was under the superintendence of the Minister of the Interior, while the forest administration lay with the Minister of Finance. The Senate of the University, at his instance, solicited, through the Minister of the Interior, the establishment of a special Extraordinary Professorship of Forest Science, 'free from the distracting influence of a forest charge', and, in consequence of this, Forest Assistant Dr Tuisco Lorey, of Darmstadt, now Professor of Forest Science in the University of Tubingen, and Director of the station for forestal experimental research there, was, by decree of 13th October, 1873, nominated Extraordinary Professor to the Faculty of Philosophy, and second teacher of forest science.

In addition to what interest may attach to these details in themselves, they acquire some interest from the circumstances that the expediency of combining Schools of Forestry with educational institutions of a more comprehensive character, instead of organising and maintaining them as separate establishments, was becoming one of the questions of the day amongst forest officials on the Continent of Europe, and may be one of some importance to those who may be disposed to advocate the establishment of Schools of Forestry elsewhere. There are national usages giving form to the evolution or development, but the general principles underlying these may be discerned; and now only can the school be considered as having attained its special development.

Dr Hess has laboured zealously to perfect, if possible, the course of instruction in forestry, scientific and practical, which is given at Giessen. Of the scheme of instruction which is at present being carried out, the following, embracing the time from Easter 1877, to Easter 1879, are details as given by him :—

During the summer session of 1877, or the first session of the course, daily from 10 to 11, or from 10 to 12, so as to secure eight hours a week for the purpose, instruction was given by him in the encyclopædia and methodology of forest science, in connection with a historical introduction, and with a special reference to forest statistics, for forest economists, rural economists, and financiers; and the Saturday afternoons were devoted to a course of practical instruction in *Waldbau*, or Sylviculture.

During the same session Dr T. Lorey, the second professor of forest science, twice a week, from 2 to 4 o'clock, gave instruction in forest road making, and spent with the students the Wednesday afternoons in excursions and demonstrations, and on one day in the week, from 11 to 1, in a *Repititorium*, or examination, on the application of geodesy, or land-surveying, to the special requirements of forest measurement and forest divisions for culture and exploitation.

In the summer session of 1878, the third of this course, instruction was given by Dr Hess one hour on five days of the week, on *Waldbau*, or Sylviculture, with practical exercises and excursions, to which were devoted the Saturday afternoons; and by Dr Lorey instruction was given for one hour twice a week on *Forstaushaltungskunde*, or the time which forests in given conditions will hold out in yielding products of a given quantity. And on three days a week one hour was devoted to a *Repititorium*, relative to forest road engineering, to the study of which Wednesday afternoons also were devoted.

In the winter session of 1878 Dr Hess gave instruction for one hour, five days a week, on forest conservation, *Forst Schutze*, and on *Forstbenutzung*, or exploitation, with

practical exercises and excursions, to which the Saturday afternoons were devoted.

Dr Lorey, on four days a week, gave instruction for an hour on wood mensuration, in connection with forest surveying, &c.; the Wednesday afternoons were devoted to the latter, and on Saturday two hours were spent by him in giving instruction in matters relating to the chase.

In the winter session of 1878-79—the fourth of the course, Dr Hess gave instruction for one hour, on four days of the week in *Waldtragsregelung*, or regulation of the produce of forests so as to secure sustained production; and one hour a day, on two days a week, to instruction applicable to the management of State forests; and a practical course of instruction in *Forstbenutzung* or exploitation, to which were devoted the Saturday afternoons.

Dr Lorey, in the same session, gave on two days a week, two hours' instruction in *Waldwerthrechnung*, or the estimating of the value of forests, and in forest statistics; and two hours on Tuesday to a *Repititorium* relative to exercises in wood measurement, to which Wednesday afternoons were devoted.

Full courses of lectures were given every year by professors in the University on the following fundamental and accessory subjects pertaining to forest science—Mathematics, geodesy or land surveying, physics, chemistry, zoology, systematic botany, physiology of plants, mineralogy, geognosy or physical geography, geology, political economy, law in its various applications, civil engineering, technology, &c.; besides which, lectures were given by professors and University tutors on mineralogy, law, architecture, and civil engineering and on the following subjects in botany in reference to the special requirements of the forest department of study:—

1. An exposition of forest plants.
2. Discussion of diseases of cultivated plants, with a special reference to lignous vegetables.
3. Mineralogy and soils, in relation to woods and forests.

4. Forest laws.

5. The drawing of diagrams, &c.

6. And agricultural analysis, &c., in the laboratory for rural and forest economy.

And in every session an introductory lecture, open to all, was delivered by the forest teacher.

The study of forestry was included in the Faculty of Philosophy. As has been intimated, there were two professorships of forest science, a first and a second; the former an ordinary, the second an extraordinary professor, being so appointed in accordance with a usage in Germany—both being independent, but the ordinary professor only having a seat in the *Senatus Academicus*.

In a *Verzeichniss*, or notice of the lectures and practical exercises in the department of forest science, and fundamental and accessory sciences pertaining to it, to be held in the University, arranged as a *Lehrplan*, showing on what days, and at what hours, in all of the sessions in the course of study from Easter 1881, to Easter 1883, issued by Dr Hess, these would be held—there are given the classes held by between twelve and twenty different professors which may be attended without interfering with each other; and in a preface he gives to students, who at Universities on the Continent have much greater liberty in regard to attending or absenting themselves from class lectures than is the case in Scotland, his advice in regard to the course of study which they should follow with a view to the acquisition of instruction in forest science. In this he says:—1. 'If it be at all possible, the lectures on mathematics, physics, chemistry, and land-surveying, should be attended in the first session, and even before entering on the special studies of the department, if this be practicable, in order that the preliminary examinations which may be passed by candidates without having attended a University for any specified period, may be undertaken as soon as possible.

2. 'With advantage, other lectures in fundamental and



accessary sciences may be attended during the first session: such as botany, theory of political economy, and with this the science of finance, jurisprudence, and forest law; and the encyclopædic study of rural economy and other accessary studies had better be deferred to a subsequent session.

3. 'The Forest Science lectures, according to this programme, will be most advantageously attended in the second year of the course; it would, however, be expedient for students commencing at this time, Easter 1881, to attend at least the encyclopædic lectures on forest science at once, as these are not again delivered until the summer session of 1883; and moreover, they will thus be placed in a position to undertake their true professional forestal studies in any subsequent session which they may choose.

4. 'The attendance on the practical forestal course of instruction, relative to silviculture, forest exploitation, the making of the forest roads, the science and practice of measuring timber, &c., with or without attendance on lectures, presents itself for the same reason as a course of instruction to be followed from the very commencement of the course. This course of study is, in other lands, required as a preliminary to entering a forest institute.

5. 'It is greatly to be desired that the students, with a view to the utilisation of the advantages for general culture, which the University offers in such abundance, in comparison with the isolated Schools of Forestry, should not rest satisfied with attending those lectures which relate to subjects embraced in *Hochschule* or State examinations: but that they should also attend the lectures in the departments of forest zoology, history, and philosophy strictly so called.'

It is added that the professors of forest science will always be ready to give information and advice to students in regard to their studies; and there is appended to the programme a list of treatises on different subjects of study recommended to students.

At Giessen, as at several other Universities in

Germany, it has long been the custom, and was the custom then, that there is no required course of study prescribed. Every student is free to choose what course of lectures he may wish to attend. He has only personally to wait upon the teacher whose class he desires to attend at the commencement of the session, and enrol himself on the class list.

Without special permission of the teacher no one can attend as a visitor above three times, and attendance beyond this is considered equivalent to a declaration of a purpose to attend as a regular student; but it does not relieve him of the necessity of formally announcing this to the teacher. And on demand every student receives a half-year's certificate in regard to the regularity, diligence, and improvement with which he has attended the meetings of the class.

The summer session begins, or did then, between the middle and the end of April; the winter session at the end of October.

The educational helps in the study of forestry consisted of:—

1. Collections of wood, charcoal, seeds, insects, birds, beasts, foods, stones, implements, models, &c.

2. The academy forest garden, or arboretum, 6 hectares, or 14 acres in extent, with a special forest museum and overseer's dwelling, all under the superintendence of the forest teacher.

3. The forests of Giessen and Schuffenberg, both in the immediate vicinity of the town.

And the helps in the study of general science were these:—A chemical laboratory; cabinets of physical, meteorological, surveying, mathematical, technological, and mineralogical apparatus and substances; a botanical museum; a botanic garden; the institute of rural economy, the institute of fine arts, the institute and cabinet of zoology and comparative anatomy, the cabinet of art, science, and antiquities, &c., &c., and finally the University library and reading-room.

The forest exercises and excursions conducted by the two teachers had for their object the execution of work required in the management of forests connected with sowing and planting, the determination of sites of fellings, and the actual felling of trees ; or the execution of appointed exercises in land mensuration, in forest surveying, levelling, and staking out of forest roads ; or the professional inspection of characteristic or typical management of forests in the vicinity, oak coppice, beech timberforests, pine clearings, &c. Of these excursions and exercises, or at least of a portion of them, a formal report was required from the students ; beside which, in every summer session, a vacation tour, extending over eight days or a fortnight, was made under the guidance of one or other of the teachers, to some of the larger forest districts at a greater distance.

The fees for attendance throughout the session for a course of lectures, which occupied from two to three hours a week, was eleven marks ; if it occupied from four to six hours a week, sixteen marks ; if from seven to nine hours a week, twenty-one marks. The mark is equivalent to a shilling.

For a course of lectures, with which excursions and associated experiments were combined, at least double these fees were payable. Attendance a second year on the same course was charged only half the amount of the first fee.

In order to matriculation a native of the principality was required to produce—

(a) A *Maturitätszeugniss*, or certificate of complete attendance at a gymnasium or at a *real schule* of the first order—that is a school in which not only languages but the arts and sciences are taught—or of some equivalent institution.

(b) A dismissal or exit certificate of some previously attended University or professional educational institute ;—and as *licenciates*, might be received those who, in lack of such certificates, produced corresponding certificates in regard to their general education.

A foreigner required, besides the education necessary to understand the academy lectures on general science, only a credible statement from his parents or guardians of consent to his attending the University, and a certificate from any educational institute which he might have previously attended.

Dr Hess has zealously and successfully made use of the press to create, sustain, and intensify an interest in their professional work amongst students who have come under his influence, and to diffuse a corresponding interest in this amongst others; and thus he has done much to promote the study of forest science, and to facilitate this by aspirants for employment in the forest service of the State.

In 1873 he published a scheme of lectures on the encyclopædic and methodology of Forest Science\* with copious—I had almost said innumerable—citations of the titles of books, in which the subjects of different chapters are treated of. I do not know of a more valuable repertory of the same, and from statements in the preface something may be learned of the conditions of forest science at the time he entered on his professional duties.

In this preface, while stating that there did not exist any such work which could be said to supply a simple and exclusive encyclopædic view of forest science, which could be made the basis of acadium study, he says in regard to the methodic scientific of forestry, that the work of the immortal Hundeshagen, of which an edition had been published by Klauprecht, must ever be assigned the first position.\*

[Hundeshagen: *Encyclopædie der Forstwissenschaft*, Herausgegeben von Klauprecht 3, Abtheilung, Fubengen.

1. 'Abtheilung: Forstliche Productionslehre, 4 Auflage, 1842.' (1821);

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\* *Grundriss zu Vorlesung über Encyclopædie und Methodologie der Forstwissenschaft* &c. Giessen: J. Recher'sche, Buchhandlung, 1873.

2. 'Abtheilungen : Forstliche Gewerbslehre, 4 Auflage, 1843.' (1822);

3. 'Abtheilung : Lehrbuch der Forstpolizei, 4 Auflage, 1859.' (1831).]

'The contents of this work, however, are to some considerable extent antiquated, having been published previous to the later forward bounds made by forest science—since it has become an essential of all true progress to take into account mathematical data, to which formerly less attention could be given.

The *Grundriss* of Cotta,\* and the generally commendable, and, in some of its parts, most excellent and elaborate Lehrbuch of Fischbach [Fischbach, C.: Lehrbuch der Forstwissenschaft, 2 Auflage, Stuttgart, 1865,] are, at least for the requirements of students at Giessen, insufficient, mainly on this account that they treat the department of forest mathematics with neglect. In neither is the subject of forest statistics treated of, and this on the ground, it is alleged by Fischbach (p. 82), that this department of forest science is, or was at the time he wrote, as yet too imperfectly developed, and for beginners, moreover, difficult to be understood. And the scheme of lectures had been prepared with a special view to the requirements of students of forest economics and of finance, it being his opinion that after the knowledge of *Betriebslehre* exploitation, and especially of statistics, if not to be placed in the same category, there is scarcely a more important, or indeed more interesting branch of study than the science of production.

'The *Forstwirthschaft* of Pfeil, edited by Prissler [Die Forstwirthschaft nach rein Practischer Ansicht, 6 Auflage Herausgegeben von Prissler, Leipzig, 1870,] comes very near to supplying what is wanted in a preparatory school, in which the object is to instruct the students how to obtain pecuniary returns from an appropriate management of forests, and in a school of financial economy;

\* Cotta, H.: *Grundriss der Forstwissenschaft*, 6 Auflage, Herausgegeben von Seine Euklens Heinrich und Ernst von Cotta, Leipzig, 1872. (1831.)

but, as its title indicates, it was designed to supply a desideratum other than that which is under consideration. As a handbook supplying the information generally required by those who are, or purpose to be, forest managers, it will do good service ; but it is not suitable as a manual of instruction for academic lectures, and objection may be taken to the plan of the work.

‘Hartig’s *System und Aleitung zum studium der Forstwirtschaftslehre* [Leipzig, 1858], contains many excellent thoughts, but the peculiar form and manner of the entire grouping is so very different from the system of the course of instruction in forestry followed in the School of Forestry at Giessen that I cannot base my course of instruction upon it. The same remarks may be made in regard to the last edition which has appeared of G. L. Hartig’s *Lehrbuch für Förster* [10 Auflage, herausgegeben von G. L. Hartig. Stuttgart, 1861,] the first volume of which scarcely comes within the designation *Fachwissenschaft*. The *Forstlehre* of Grunert is calculated to meet the requirements of Prussian foresters. Also, the old *Lehrbuch für Förster* of G. L. Hartig, revised by Berggreve [1871], can only be viewed in this light ; and, lastly, the *Forstencyklopädie* by Püschel, in consequence of the alphabetical arrangement followed, can only be used as a book of reference.’

He says it was thus that it was rendered necessary for him to prepare a *Forest Encyclopædia* of seven volumes, the publication of which was necessarily deferred ; and that the brochure, which was little else than a table of contents, was published for the assistance of his auditors. Fundamentally, the system first used was that of the Hundeshagen school ; but in the working out of the several parts he had followed the two Heyers, Carl and Gustav. In the discussion of forest police, of which he had only to treat within the narrow limits of *Privatforstwirtschaftslehre*, he had not followed the limits of any particular school, and the same might be said in regard to certain portions

which he had introduced in the introduction, and in the parts relating to statistics.

With regard to the several works cited, he says he would by no means have it understood that these are all the works published on the matters to which they severally referred. To beginners the teacher, according to my mind, says he, should only recommend tried leaders. This volume, as stated, was published in 1873.

In the periodical, *Deutsche Zeit-und Streit-Fragen*, for 1874, published in Berlin, is a paper occupying two entire numbers, entitled *Die Forstliche Unterrichtsfrage*, by Dr Hess, in which are given details of the previous history of the question whether Schools of Forestry should be associated with Universities and Colleges, or be maintained as independent institutions; reasons for the combination of the Schools of Forestry with the *Hochschulen*; statements of the advantages offered by Universities for giving instruction in forestry and forest science, and a review of objections to the measures which have been raised.

To this subject much attention has been given of late years; and the combination of arrangements for the study of forestry with those of existing Universities, and similar institutions, should not be considered an innovation, but a return to an early practice. It was in the University of Berlin that forestry was first taught in Prussia, and thus was it in Giessen. And in view of that early arrangement, not only may Giessen claim to have been the first University in Europe in which this arrangement has been restored, but it may lay claim to be considered the first, or one of the first, Schools of Forestry established in Europe, taking precedence both of that founded by Cotta in Zilbach in 1795, and of one founded in Hungen by Martio in 1791, and long before that giving origin to the Academy in Eisenach. In a volume published by Dr. Hess in 1831, entitled *Die Forstwissenschaftlichen Unterricht an der Universität Giessen in Vergangenheit und Gegenwart*: Instruction in forest

science in the University of Giessen, in the past and in the present—he divides the past history of instruction in forestry in the University of Giessen into three periods—the first of which he designates that of instruction in forest science in the University in connection with political economy, which he states to be the period comprising from 1788 to 1824; the second period in which this was taught in a special School of Forestry from 1825 to 1831, a comparatively short period of six years; the third period that of the existing university forest instruction from 1832 to 1881 inclusive, comprising half a century.

In this volume are given details of the existing arrangements for the study of forestry; of the expense of the organisation and the instruction imparted; and of the duties of the teachers, with tabulated statements of the nationalities of the students in each session since 1825 to the present time, and of the College attendance, and present professional position of all surviving students.

In 1876 he published a Scheme of Lectures on Forest Economy. And, in the same year, he published an introductory lecture, delivered before the University, *Über die organisation die forstlichen Versuchswesens*: On the organisation of forestal researches—a matter which has of late years commanded much attention.

He had previously published pamphlets on the same subject in 1870 and in 1872. He has issued also numerous fly leaves for the guidance and help of students and forest officials in making observations prosecuting experiments and calculating results in furtherance of the advancement of forest science, and larger works designed to advance the same.

The instruction at Giessen is regulated by order of 31st July, 1879, with alterations according to order of 22nd December, 1883. As has been intimated, there is no special forest district for purposes of instruction but forests around Giessen, and the railway combinations afford excellent facilities for reaching these. The number of students in the summer of 1885 was 44; in the winter of 1885-86, 47; of whom 7 were not Hessian subjects.



## CHAPTER VI.

### THE ROYAL BAVARIAN CENTRAL FOREST ACADEMY AT ASCHAFFENBURG, AND CLASSES FOR THE STUDY OF FORESTRY IN THE ROYAL LUDWIG-MAXIMILIAN'S UNIVERSITY IN MUNICH.

THE University of Giessen in Hesse Darmstadt, has become famous through the result of researches by Professor Baron von Leibig, and the numerous students whom his enthusiasm, and science, and skill, attracted to the laboratory under his charge; and the Royal Bavarian Central Forest Academy at Aschaffenburg has been made famous by the researches of Professor Dr Ernst Ebermayer, who here laboured as professor, and here began and conducted observations and studies of climatology in connection with the meteorological influences exercised by forests, which have commanded a world-wide commendation.

I have not had an opportunity of visiting Aschaffenburg, having passed through Bavaria much further to the south, *via* Munich, *en route* to Vienna, to visit the International Exhibition held there in 1873; but the history of forestal studies in the Academy has been long known to me.

Aschaffenburg is situated in the northern part of Bavaria, and is easily reached by railway from Darmstadt, or from Frankfort. It is a town which has had its origin traced, or at least attributed, to its having been the station of the 10th and 23rd legions of the Roman army.

The School of Forestry designated *Der Königlich Bayerischen Central-Forst-Lehranstalt*, stands in the Alexandra Strasse. It is a three-storied building of freestone,

130 feet long, standing in an open court; and behind this is the botanic garden.

On the ground flat are two large lecture rooms, a chemical laboratory, a hall containing objects and equipments connected with the chase, and a collection of models, with apartments for the use of the house steward and the beadle. In the second storey there is the business room of the director, the office of the actuaries, a lecture room, a large room for the drawing classes, the library, a hall containing mathematical instruments and apparatus pertaining to natural philosophy, &c.; and in the third storey are six halls containing other collections of objects and apparatus used in the institution.

As may be gathered from some of these statements, there is, or was, for I write of the past, provided for school purposes a collection of instruments and implements, and models of structures employed in forest economy; a collection of forest products, natural and manufactured; a collection of objects connected with the chase, one of agricultural implements, a zoological collection, a mineralogical collection, a botanical collection and garden; a collection of mathematical instruments, and of apparatus illustrative of all departments of natural philosophy; a collection of drawing instruments, a library of works in all departments of forest science, and a chemical laboratory with all requisite apparatus and requirements, and similar work rooms for the study of zoology and other departments of natural history and physical science.

Thus was the Academy equipped when I had occasion to make enquiries on the subject; but there have been changes of which more particular mention will afterwards be made, and I have not at command information in regard to effects which these have had on the equipments which then existed.

In a brochure entitled *The Schools of Forestry in Europe: A Plea for the Creation of a School of Forestry in connection with the Arboretum in Edinburgh*, which I pub-

lished in 1877, I stated that, preparatory to entering this institution, students were required to have passed through a gymnasium satisfactorily, and, with the sanction of Government, to have passed through a preliminary instruction of eight months, extending from September to May, under a *revier*, or district forester, approved and appointed by Government; to be not above 23 years of age; and to possess means of support during the period required for attendance at the forest school.

The instruction given in the school embraced—(1) Forest Science, or theory of forest administration in all that relates thereto; the physiology of arboreal and arborescent vegetation; forest culture; forest economy and technology, including road making, bridge making, and house building, the preparation of charcoal, potash, turpentine, tar, and lamp-black; the theory underlying forest conservation and forest management in the practical regulations of operations throughout an extensive district.

(2) Physical science, more especially general and economic botany, the latter having special regard to plants of importance to the well-being of the forest and the interests of the country, with practical instruction in gardening; mineralogy, including geognesy and geology, with the use of the blow-pipe; zoology, embracing the natural history of animals interesting to the forester, the huntsman, and the agriculturist, and more especially that of noxious insects and of game; and finally, natural philosophy, including organic, inorganic, and analytic chemistry, in their application to forests and agricultural operations, with experimental analysis of soil, of ashes of plants, of water, of air, and of manures.

(3) Mathematics, including algebra, plane geometry, cubic mensuration, trigonometry, statics, dynamics, optics; mensuration, with practical applications; instruction in preparation of charts, in taking levels, and in estimating the condition and value of forests.

(4) The theory of State management of forests, forest

police, forest legislation, forest administration, and the practical management of forests.

(5) Agriculture, with a special reference to soils, culture, manure, meadow culture, grain culture, and the theory of administration.

(6) A comprehensive theory of the chase: principles and rules for the management of game, *reviern* with deer, boar parks, and pheasantries, and for the utilisation of game—for the hunting or taking of game; and those of the game laws.

Instruction was given by encyclopædic lectures, with illustrations of the practical application of theoretic statements in excursions conducted by the professors, in forests near and distant; and necessary assistance toward meeting the expenses of such excursions was given to the poorer students.

The year of study began fourteen days after Easter, and extended over  $2\frac{1}{2}$  years. In addition to this, those who aspired to the higher forest appointments—*e.g.*, those of forest master and upward—after finishing their course at the forest school, were required to prosecute the study of science at one or other of the State Universities at Munich and Wurtzburg; and after this, as at the conclusion of their course at Aschaffenburg, to undergo an examination on the required subjects of study.

Promotion to a higher appointment in the forest service was also dependent on a strict examination, and not more than one opportunity of passing was allowed.

Non-professional students and foreigners might join the forest school, but only on condition that they possessed the necessary qualifications for understanding the instructions given, and that they gave a written declaration that it was not their intention to enter the Bavarian forest service.

For Bavarian subjects the fee was  $12\frac{1}{2}$  florins (25s), and for foreigners 25 fls. (50s) per half-year. Besides this, every candidate had to pay a matriculation fee of 4 fls. (8s), and a similar fee for certificate at the close.

Candidates were subject to a rule of discipline, and were

bound to a prescribed college course. Foreigners might obtain from the director a dispensation from particular studies. For the sons of Government officials, and more especially of those who were in the forest service, who were without the means of meeting the expenses, there were provided five scholarships of 250 fls. (£25), ten of 200 fls (£20), and ten of 150 fls. (£15), and also five scholarships of 250 fls. (£25) for forest candidates of limited means who desired to go to the Universities named to prosecute their studies.

The college staff consisted of a director, who, together with the first professor of forest science, had the rank of a Government and Circuit Forest Councillor, and four other professors with the rank of forest masters, and a *revier* or district forester, who acted as lecturer and as actuary clerk.

The direction and control of the school was vested in the Minister of Finance and the Church and School Department of the Bureau of the Minister of the Interior; and in subordination to them was the director of the school.

To the director pertained the maintenance of order, the superintendence of the course of study and instruction, the granting of certificates, and everything connected with the management of the institution which had not been specially and expressly committed to the director and professors conjointly.

Students on finishing the curriculum at Aschaffenburg either entered on further practical training in the forest or in a forest office, or on attendance at a course of lectures on Political Economy at the University; and they afterwards received appointments to Government employment in the order of the excellence of the testimonials they have obtained.

In general the practitioner was not allowed, without forfeiture of all title to Government employment, to leave the service till he had attained the first or lowest grade of a Government official; but in special cases exemption from conformity to this requirement might be granted by the Government of the *Kreis*, Circuit or District.

The following is a more detailed account of later arrangements derived from the published *Programm und Satzungen für die Candidaten*.

The Institution was under the immediate control of the Minister of Finance and the Minister of the Interior for Religion and Education.

The body of teachers was comprised of a Director, appointed by the Crown, and who was also first Professor of Forest Science; with two or three Ordinary Professors also appointed by the Crown.

(a) A Professor of Chemistry and Mineralogy. (b) A Professor of Mathematics and Physics. (c) A Professor of State Forest Economy and Surveying. And, (a) A Lecturer on the Management of Forests. (b) A Lecturer on Botany. (c) A Lecturer on Zoology. (d) A Lecturer on Road-making and the Chase. (e) A Lecturer on the Mensuration of Woods and Forests, and (f) A Lecturer on Political Economy in its reference to Forest Science and Forest Laws.

Of all candidates for admission to the Institution, there were required—

1. Gymnasium certificate.
2. Certificates of having spent eight months in forest work in the State forest.
3. Certificates of age and of baptism.
4. Certificates of health and of possession of the bodily vigour requisite for the forest service, and of perfect sight and hearing.
5. Declaration of consent of parents or of guardians, when the candidate was not himself of age.
6. Legal guarantee of the possession of means of subsistence while under instruction.

Within eight days after matriculation they must find lodgings and report their address, and subsequently report any change in this, and they must at all times be prepared to produce, on demand, their ticket of residence obtained from the police. Candidates who were foreigners required only to produce evidence of their possessing the education necessary to enable them to understand the instruction given, of their good moral character and of

the approval by their parents or legal guardians of their attending the institution.

Aspirants to employment in the forest service of the State, or of the large forest proprietors, and also sons of the latter, who could not produce all the pre-requisites to admission as regular students, but who could produce certificates of good moral character and of possessing the education necessary to their understanding the instruction given, might, as also might foreigners, be received at the Institution as *Hospitanten*.

Regular students were required to attend every class in its order; but to the *Hospitanten*, whether Bavarians or foreigners, it was allowed to choose what classes they should join, and of both of these classes there was required a promise of submission to the laws and bye-laws of the institution, copies of which were shown to them on their entrance.

The curriculum of study at Aschaffenburg embraced three different courses, and extended over two and a half years. The first course began eight days after Easter, and ended on the 31st of July. The second and third began on the 31st October, and ended on the 31st July in the following year—with a vacation of fourteen days at Easter.

In accordance with a resolution of the Minister of State, under date of 24th January, 1865, No 415, slightly modified subsequently as occasions required, the first course consisted of introductory studies.

Three hours weekly were given to the study of botany, the province of which science was explained, with the terminology employed, combined with illustrations in the garden; the requisites of vegetation were shown to be soil, moisture, air, light, and heat; and the distribution of plants was explained and accounted for.

Two hours a week were devoted to zoology, the organisation of animals, and the classification founded on this, and the characteristics of the vertebrata.

Four hours a week were given to chemistry, including exposition of chemical affinity and chemical notation,

specific gravity, of combining proportions of elementary substances, and the special study of the non-metallic substances and their compounds, which have a special interest as nutriment of plants, or as constituents of the earth and of different kinds of mountains.

Three hours a week were given to physics, more especially statics and dynamics of solid bodies, with experiments illustrative of the mathematical laws by which these are regulated. Three hours a week were given to mathematics, more especially to plain geometry; and three hours a-week to algebra.

Four hours a week were given to chart and plan drawing, with instruction in the theory of projection; and in the nature of materials used in the construction of instruments employed, and in illustration of the use of them; and two hours a week were given to the study of political economy.

The second course of instruction was carried through two sessions.

In the first, or winter session, of the second course, three hours a week were given to the study of forest management, and the profitable production of wood.

Two hours a week to instruction in the game laws and the chase.

Four hours to botany, embracing the study of embryos and of forms of the elementary organs of plants, and the functions of the several organs, the nourishment and growth of plants, the classification of these, and forest botany, with demonstrations in the garden.

Three hours a week were given to zoology, embracing the natural history of vertebrate animals profitable or injurious in connection with forests, and of forest game, with demonstrations on collections of these belonging to the institution.

Two hours a week were given to inorganic chemistry and the study of the lighter metals, and of their more



important compounds, with a special reference to the analytical decomposition of these.

Three hours a week were given to mineralogy—crystallography, physical constitution of minerals, their phenomena under the blow-pipe and in solution, and the determination of different kinds of mineral substances.

Five hours a week were given to physics, embracing the study of atomics, hydrostatics, pneumatics, heat, acoustics, optics, magnetism, electricity, and meteorology and modes of making and recording meteorological observations.

Three hours a week were given to mathematics, trigonometry, and the mensuration of solids, and four hours weekly to plan drawing and the representation of various natural and artificial objects and crops, by the pen.

In the summer session there were devoted to the study of forest management four hours weekly; and two hours to forest protection, in so far as it does not come within the range of forest management, zoology, and meteorology; two hours to matters pertaining to the chase; two hours to botany, with the use of the microscope, in studying the histology of plants; to zoology and the study of the vertebrate two hours; to inorganic chemistry and the study of the heavy metals and their compounds two hours; the chemical analysis (qualitative) of soils, of ashes, of plants, of limestone, and of water, &c., two hours, and to mensuration three hours; and to plan drawing of various kinds four hours were given weekly in the course of the session.

The third course of instruction also extended over two sessions.

In the winter session of the third course four hours were given weekly to the study of systematic forest management, including the study of the object to be arrived at in the work, and of the different means by which the attainment of it had been sought, and the historical order of development of forest economy;

three hours weekly to the pecuniary profit of woods, including instruction in regard to the felling of trees, the bringing out of timber, the transport of wood, and the preparation and disposal of other forest products; three hours a week to the study of the management of State forests, embracing the study of the function of forests in nature and in States, and the duty of States in relation to forests belonging to the State, to communes, and to private proprietors; two hours to zoology of insects, profitable or hurtful to forests; two hours a week were given to the study of organic chemistry, in vegetable products; one hour weekly to agricultural chemistry, embracing everything relating to the chemistry of vegetation; one hour weekly was given to the study of soils and everything relating to them, and two hours to geology and mineralogy; three hours to the study of forest engineering, embracing road-making, levelling, bridge building, and dam-making; three hours a week to mensuration in all its departments and details, with two hours a week to the measurement of cubic contents of growing trees, and of wood contents of forests.

In the summer session of the third course—the fifth and last of the curriculum—four hours a week continued to be given to the study of systematic forest management, embracing the practical application of instructions previously given, the description and the estimation of contents of woods, and the wholeround of forest operations were more minutely studied in excursions; three hours a week were given to the study of forest laws, three to that of forest administration, three to that of rural economy, soils, tillage, manures, theory of fallows, and of alternations of crops, and the study of cereal and other crops and meadows; two hours a week to the estimation of pecuniary value of forests; and three hours a week to forest engineering, embracing what of hydraulic engineering relates to forests, and all connected therewith—hydro-metry, evaporation, mensuration of water-flow in fountains and streams, drainage and irrigation, consolidation of river

banks, &c.; erection of houses and other structures required in connection with forestry. Along with these arrangements for the communication of instruction in the class-rooms, corresponding arrangements were made for demonstrations and exercises in the practical application of what is learned in the academy—which was given in the forest, there being very great facilities presented in the immediate vicinity of Aschaffenburg. In the immediate vicinity of the town were public parks, presenting features characteristic of a scientific arboretum; not far off there were facilities for making geological observations on the western boundary of the Spessart; and in this forest, which is the property of the State, were upwards of a hundred thousand *Tagwerken*, or *well-nigh a hundred and twenty thousand acres* of oak and beech woods;—while within the forest and around it there were works in which forest products were used; and facilities presented themselves for the study of the chase. At somewhat greater distance in Hesse, might be studied the forest economy of coniferæ; and various forms of forest management might be studied in Odenwald, on the plains of the Rhine to the west of Aschaffenburg, and in the Palatinate. At a greater distance were the beech forests of the mountains of the Rhone and of the Steigerwald, and the pine and fir forests of France, and those of the Black Forest. And the railway intercommunication is such that all of these could be reached with little waste of time.

The arrangements for excursions were the following:—The Director of the Academy, who was also first Professor of Forest Science, in the second course of instruction, illustrated and established his instruction in forest management by practical operations in forests around Aschaffenburg, and availed himself for this purpose of every case of a forest district presenting anything remarkable in its culture or exploitation; and by experimental sowings and plantings of different kinds of seeds, and this with different kinds of implements.

In the third course of instruction he was required to illustrate his instruction in systematic forest management by devoting from fifteen to twenty days at least to practical measurements, calculations of annual increase, estimates of pecuniary value, determinations of vigour of vegetation, and descriptions of trees. And he was required every year to go through, with the students on the ground, the whole system of management to which a forest is subjected, for which the public forests in the vicinity supplied admirable facility; and a complete plan of operations, founded on this, had to be prepared by the students.

The second professor of forest science in his excursions with the students, had mainly to do with the ingathering and utilisation of forest products, the manufacture and disposal of these, the collection of accessory products of woods, such as bark, peat, &c., and the fixation of sand downs, and all that relates to the chase.

The professor of botany and zoology gave his attention to botanical demonstrations and exercises, the determination and classification of plants, according to the Linnean and the natural systems, and to similar entomological demonstrations, for which injured pine trees abounding in some of the public forests in the vicinity of Aschaffenburg, presented a good opportunity.

The professor of mineralogy and rural economy took his students on excursions for illustrations of his instructions in these subjects. And the professor of mathematics exercised the students in all departments of the practical application of these required in the management of forests, in land surveying, levelling, and road projecting—with the preparation of diagrams of the same, and calculations of the cubic contents of earth required, or of earth to be removed, &c.

Besides the excursions which could be accomplished in a single day, to which the Saturdays were as a general rule devoted, there were excursions to the forest districts of the Spessart, to the Odenwald, to the plains of the

Rhine, the Black Forest, the Taunus mountains, and the mountain ranges of the Rhine, which occupied from eight to fourteen days, and which were determined by circumstances, and conducted by the professor of forest science, with the assistance of the professor of geognosy or physical geography. And while these were being carried out, the other professors gave their time to all the students who remained in the Academy.

As these excursions were an integral part of the course of instruction, attendance was obligatory, and with this view provision was made for the expense of the longer journeys, being, in the case of students of limited means supplied to them.

On approval, admission and matriculation, Bavarian students, as has been stated, paid a fee of 12½ florins for the first part of a single session, and of 25 florins a year for each of the other courses. Foreigners paid fees of 25 florins and of 50 florins for these respectively. Besides this every candidate, without exception, paid 4 florins for his ticket of matriculation, and a like amount for his certificate on leaving the institution.

For sons of officers of limited means, in the service of the Crown, and more especially in the forest service, attending the institution, there were set aside annually:—

10	bursaries of	-	-	150	florins.
10	Do.	-	-	200	„
5	Do.	-	-	250	„

And, besides these, 4 bursaries of 250 florins yearly.

To forest candidates of limited means, who had acquitted themselves well at the institution, and who wished to attend the course of lectures on political economy at the University in Munich or Wurzburg, and to candidates in the first course of a single session a small portion of the aforesaid bursaries might be advanced.

The bursaries might be forfeited by want of diligence in study, or by culpable misconduct; and to remove temptation to submit to undue privations, or culpably to contract debt and injure their parents or creditors, the certificate

to be given at the close of the session might, with the sanction of the director, be pledged in anticipation for debts for medical attendance and medicine to the full amount; or for food, clothes, or books, to the amount of 20 florins; for lodgings, goods, shoes, stationery, and washing, to the amount of 10 florins, but not more; and all pawning of possessions was prohibited.

General or trial examinations were held at Easter to enable the professors to judge of the progress being made by the students, and in autumn to determine their admission to the more advanced course of instruction. It was not compulsory on foreigners to submit to these examinations, and it was allowed to them to undergo separate trial examinations, for which special times were appointed by the professors.

Numerical values were attached to the measures of success with which students passed through the different examinations, and, according to the sum of these, was the certificate which was given to the student determined. The certificate related to diligence, to attainments, and to behaviour while in the institution.

In the exercise of discipline, various degrees of censure were sanctioned. The simplest was admonition, and the most severe was censure followed by expulsion. Records were preserved of all censures and punishments inflicted, and by these the terms of the certificate granted to the students on leaving the institution might be modified.

Such was the School of Forestry at Aschaffenburg when I had occasion to make myself acquainted with its arrangements; and as supplying information in regard to such institutions, the report will hold good for all time.

Reference has been made to changes which have taken place since these regulations were issued, and the history of the school is not devoid of interest. The following is a translation of a narration of this to the time at which it was issued:—

In 1807 there came together at Aschaffenburg several professional students, and administrators of forest economy, to arrange a course of study which might advantageously be followed at a forest school with a view to the establishment of one there as a private institute. In this they succeeded, and as such the institute existed for a considerable time. The Prince Primate took a hearty interest in the scheme, and adopted measures to raise it to the position of a State Institute. He granted for it a *locale* in the Schönthal, and a portion of the Spessart for its maintenance and use.

There were political difficulties in the way of the Prince Primate doing all he desired, and the elevation of the institute to the position in question was a gradual work.

In 1814, when the Principality and the City of Aschaffenburg were embodied in the Kingdom of Bavaria, there were seven teachers in the institute, of which one only was appointed to teach forest science, and that relating to the chase. The director was charged with the duties of the Spessart Forstmeister. He, as well as the other teachers of the institute, of which three were professors in other schools in the place, and one a physician, were remunerated by fees; only ten drew a salary from the State, and that amounted only to 150 florins—say £15.

The fees charged foreigners were one Caroline or louis-d'or per session, others paying half that amount; and there was allowed by the State, for experiments in physics and chemistry, 110 florins; for an attendant, 10 florins; and for fuel, 67 florins 20 kreutzer. With this addition the institute was assisted by the State to the extent of 1397 florins 2 kr.—say £140.

Of candidates for admission it was required that they should be able to write legibly, swiftly, and free from mistakes in spelling, be acquainted with the four simple rules of arithmetic, and be able to read fluently.

Lectures in the first course of instruction were given four days a week, from the beginning of November, till

the end of May. Friday was reserved for study, and Saturday for chart drawing. The month of May was spent entirely in the Spessart forest. From the first of June till the last of September was occupied with the second course of instruction; and October was spent in practical work in the forest. And thus, in the course of a year, the student completed his study of the forest science of the day.

Aschaffenburg, belonging now to Bavaria, by a Rescript of 22nd September, 1815, it was announced that the institute, having then nine students, should retain the possession theretofore enjoyed; but it was not deemed equal to what was then required of a forest institute, and considerable changes were devised and submitted for consideration by the teachers: one special object being to separate the course of instruction given to candidates for the higher from that given to candidates for the subordinate departments of the forest service of the State, and this to be so effected that in the first section youths to be employed as forest warders or guards might pass through their preparatory studies in six months, and then enter upon their further training in the forest; and that this course of school instruction should prove preparatory for superior students passing into the second section of the institute, in which they might be, in the course of a year, further instructed, so as to be fitted for the administration service; and in a third section, by a course of two years' longer instruction they might be trained for the inspector service.

In view of this the teachers, in 1816, and again in 1817, commended the institute to the favourable consideration of the Government; and, by petition under date of 29th March, 1817, the magistrates of the city, representing the depressed condition to which this had been reduced by effects of war, and by the withdrawal of officials from it as a seat of Government, prayed that it might be assisted to recover a state and condition



befitting the See of a Bishop, by the founding of a forest institute there.

Meanwhile, the Bavarian General Forest Administration had expressed an opinion which had an important bearing on such a proposal. On 15th March, 1816, they had under consideration the question, 'In what way for the future can suitable training and instruction be provided for forest officials employed in the different departments of the service?' And a report on the subject, extending over 232 pages, prepared by the Oberforstrath von Olschläger, which was not altogether favourable to the carrying out the proposal which had been made, had been submitted to the King.

In regard to that it is remarked—'An opinion to be of value must proceed on the recognition of the fact that what is required must be contemplated from two different points of view according as it may be desired to have an educational institution for the higher, or one for the subordinate departments of the service. For the latter it is to a great extent sufficient that the official learn in a purely empiric way, under skilled forest officials, the work which is to be done in the forest; though it is the case that the establishment of an institution for the instruction of such has much to be said in its favour. But, on the other hand, while this we admit, we cannot assent to the opinion expressed by the teachers at Aschaffenburg, that they have established the point that there is a necessity for the existence of an institute for the instruction of forest officials of every grade, and this one alike thoroughly equipped for the teaching of theory and practice. The provision for the one must of necessity operate injuriously on the other; and more especially do we affirm it to be impossible to send out young men from the school completely prepared for practical work. The school should only give theoretic or scientific instruction as a preparation fitting both for the superior and the subordinate appointments in the forest service. And for this a University recommends itself on the

ground that the lack of practical training there, as is also to some extent the case in forest schools, is more than counterbalanced by the greater advantage of the generally higher scientific education there attainable, while what is wanting may subsequently be acquired in actual work in the forest.' This I may remark, in passing, is an arrangement now strongly recommended.

This professional opinion, published by the General Forest Administration, states moreover, that 'on no account must the fact be overlooked that scientific forest instruction can only produce in such as possess the preliminary instruction requisite for admission to a University, the results which are desired; and that only those who have not attained so complete a preparation should be directed to a special forest institute for instruction in forestry adapted to their attainments and modes of thought, to meet which, the whole method of instruction should be adapted.'

The instruction for the lower departments of forest science, the reported opinion goes on to state, after giving a *resumé* with careful consideration of the grounds on which the opinion is based, 'might be handed over to the forest institute specially organised for this; but the higher branches of forest science should be included in the sphere of University studies.' And this latter measure is advocated specially on the ground that 'only thus can the felt want of scientific and systematically educated forest practitioners, who are required for the higher departments of the forest service, be expected to disappear, and then there might be drawn into the lower departments of the forest service of the districts men of good school education; and the forest schools which were then (1817) indispensable \* might be gradually reduced in number, or altogether given up.'

It is stated in the report that the meeting of this necessity for a University scientific instruction might

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\* There were at that time in Bavaria several private Forest Schools at Kempten, Keufreuten, and several other places,

give a valuable impulse to the general improvement of the forest economy of the country, and the introduction of the new, securing the combination of this with the old, where this has been tested by experience and proved satisfactory. Care only being required in regard to some matters lying outside the essential, the true worth of which may be readily recognised.

It is laid down that :—

1. Aspirants for employment in the higher departments of the service should go through a three years' course of instruction in the University ; and

2. For the subordinate appointments a two years' course of instruction in a Forest School ; but

3. Instead of this, for aspirants of limited means, three years' instruction in forest labours might be accepted as a valid qualification for the service.

What should be required in regard to 1 and 3 may be easily specified says the report ; but with regard to 2, the selection of a site for a School of Forestry, greater difficulty might be experienced from the small number of places being so situated as to combine all that is desirable in the site of such an institution.

The General Forest Administration specifies the following requirements in the situation of a Forest School :—

'1. It should be situated as nearly as possible in the centre of the country ; and

'2. In a place in which rent and provision are moderate in price.

'3. There should be means of securing life culture at command without temptation to waste time in amusements ; and

'4. It should be in the vicinity of forests, giving an opportunity of learning much of the many-sided methods of exploitation.

'In regard to 1, 2, and 3, Ausbach, Bamberg, and Eichstaed, might be mentioned ; in regard to 4, of these three places, Bamberg offers the greatest advantages, and next to it Eichstaed.

‘Against Aschaffenburg it may be objected its general position, and the aridity which prevails there. On the other hand, the means of instruction existing there are not unimportant: there is its proximity to the Spessart, with its forest of broad-leaved trees; its facilities for flottage, and its timber trade; there are existing there the school and its museums; and above all there speaks in its favour its attractions for foreigners; while there is already a school established there. It would be difficult in Bamberg to compete against the attractions of the Forest Schools at Dreissigacker under Bechstein, and at Tharand under Cotta, as well as the newly-founded Forest School at Fulda; and at Bamberg we could only look for foreign students from the Rhine, from Baden, and from Wurtemberg.’

The final proposal was to the effect that for these last reasons the preference should be given to Aschaffenburg; that the school to be established there should be thoroughly equipped; and that students of the country should be allowed to visit those schools in other countries with which they were competing; but that Aschaffenburg should only be considered a school for aspirants for subordinate appointments in the forest service. The National Universities, which alone supplied the best means of skilful scientific general education for all departments of the service of the State, supplying also for the training of the higher forest officials, the most suitable means of instruction in the higher forest science, and the fundamental and auxiliary sciences.

The report treats further of the organisation of the forest institute, and of the instruction to be given in it to aspirants for subordinate appointments in the service, inclusive of that of *revier*, or district forester, so as to secure, in the shortest time practicable, thorough instruction in the fundamental and auxiliary branches required in the profession adapted to the capabilities of such students.

An opportunity will afterwards present itself for a more

full description of the question raised in regard to the most desirable site for a School of Forestry.

Let it suffice to state here that the report, which was in favour of a University training and education being provided for forest officials, shows that the Forest Administration of that day (1817) had clear views of the importance of the best and highest possible education being secured for those who should be entrusted with the management of the State forests.

In July the town of Aschaffenburg again addressed the Minister of State with a pressing petition to the Crown Prince Ludwig, praying him to support the prayer of the petition they had addressed to the King some months before, that the forest institution situated in that vicinity might be maintained and extended—the first cost of doing which would be inconsiderable, and the current expense might be met out of the Aschaffenburg students fund.

The District Government, on the other hand, proposed that the education should rather be made more exclusively technical, reducing the number of professors from seven to four, giving up the study there of political economy, and of land and water engineering. And the Council of General Forest Administration, in a subsequent report, advocated the measure that in Aschaffenburg there should only be a school for the training of ordinary subordinate officials, on the ground that only in a University, or similar educational institution, can the broad and comprehensive training and instruction required in the higher departments be secured.

It seemed to be considered impossible that a School of Forestry so situated could ever become what a School of Forestry might be made. But consideration was given to the circumstance that a School of Forestry already existed there; that aid in the improvement of it was offered from a local fund; and that the town had suffered from its being incorporated in the Kingdom of Bavaria. And in accordance with an urgent renewed application from

the town, made under date of 3rd September, 1819, to the King, by Rescript dated 29th September, 1819, the establishment of a new forest school was promised; and in the autumn of 1821 this was opened with provision for instruction both for the higher and the subordinate departments of the forest service. But it was maintained afterwards that this had been done more from a regard to the interests of the town, than from professional advice.

The staff consisted of a director, four professors, a drawing master; an actuary, and a beadle.

Within a year the insufficiency of this school, for accomplishing the purpose of its organisation, it was alleged, began to appear: and in the autumn of 1823, at the instance of the Minister of Finance, a re-organisation of the school was called for. A two years' course of study was required of candidates for subordinate offices in the forest service, for entrance on which a gymnasium certificate was required of the pupils; and a more prolonged course of study was required of others, and of selected pupils to qualify for higher appointments. An increased allowance was made by the State, and the number of professors was increased.

This was effected in the year 1823-24, but in August, 1824, the district government complained of the management of the school, and in 1827 the director resigned, and difficulty was experienced in procuring efficient teachers; and by decree of 19th October, 1832, the forest institute was closed as not having fulfilled the expectations formed of the results to be obtained.

It was thought that something might be accomplished by having a school for the training of subordinates in some other and better situated locality, and by requiring the superior officials to study in a *Hoch-schule* in Munich, and transferring thither two of the professors from Aschaffenburg—a forester and a mathematician.

Nothing having been done to fulfil the first mentioned suggestion, in the Bavarian chamber, in 1840, Dr Müller brought forward a proposal that a special forest

school should be organised in which, by a course of study, extending over a year and a-half or two years, candidates might be fitted for the higher departments of the forest service of the country.

In the sitting of the 28th March the Minister of State, Von Adel, replied to the effect that the special forest school at Aschaffenburg had died a natural death; that students of theoretical forest science had now every facility afforded them in the *Hoch-schule* of Munich; that as to the practical instruction students had got little or nothing of this at the special School of Forestry now extinct; and that Government had created bursaries which might be obtained by young foresters travelling for observation or for studying practical operations under *forst meisters* or district foresters; and that Dr Müller's proposal was best,

But the desirableness of a School of Forestry for the training of subordinates was not lost sight of by the Government; and in a memorial submitted to the King on 27th May, 1842, it was stated that for the higher departments of the forest service an appropriate education might be obtained at the University, but that provision for the education and training of subordinates who might not have studied at a gymnasium, or required to do so to fit them for their duties, was still a desideratum. It was submitted that this might be supplied in connection with the so-called *Gewerbeschulen* or Trades Schools of the country; and four towns were proposed as sites for such schools—Nurnberg, Bamberg, Kaiserslautern and Anspach. It was suggested that to the *Gewerbeschulen*, in any place, there might be added two special teachers and an assistant.

It was alleged that this would entail great expense; and Aschaffenburg and Anspach, pleading the saving which might be effected, petitioned the Minister of State that one or other of them might be appointed the site of such a school.

In a note, dated 28th March, 1843, Anspach was declared to be the preferable of the two places named.

On the 13th April a conjoint report as to the necessity for some such institute was made to the King by the Minister of Finance and the Minister of the Interior; and finally, on the 25th August, it was delivered that Aschaffenburg should be the site of the school in question.

I have before me details of the comparative advantages of the two places, but I deem it enough to state the fact. Not a little was done to give prominence to the secondary character of the school, and to the superior education provided at the University; but at the University in the year 1846-47 only seven students of forestry enrolled themselves, and in the following year—1867-68—*none*; and the arrangements came to nought. The Aschaffenburg staff bestirred themselves, introduced reforms and improvements; and by ordinances issued under date of 14th September, 1848, and 26th October, 1850, it was declared that Aschaffenburg should be attended by all candidates for the higher appointments in the forest service, there to pursue the special technical or professional studies; but that this should be followed by their going through the University course of study of political economy, with the pre-requisite study at a gymnasium, or a certificate, No. 1, from the School of Forestry, which would absolve them from this last.

In the discussion of this question in the Legislature of Bavaria, the Upper Chamber of *Landesbehörden*, the superior *Forstbehörden*, and the Ministry, spoke strongly for the giving up of the Academy in Aschaffenburg, and of transferring the instruction in forest science and forestry to one of the two National Universities; but the *Ultra-montane* majority of the Chamber spoke out as one man for the maintenance of the Academy, and they voted liberally the money supposed to be necessary for a re-organization of the institution to meet the requirements of the times.



The School of Forestry—the inception of which dates from 1807, dissolved in 1832, but re-organized under the Ministry of Finance in 1874—was, by decision of the Government of 30th March, 1874, united to the University of Munich. But this was not the last of the changes which have passed upon this institution.

From a statement in the *Centralblatt für das gesammte Forstwesen* of November, 1877, I gather that the Minister of Finance had then addressed to the Bavarian Chamber of delegates a detailed printed memoir (filling 21 pages 4to), in which he expressed his decision that the Forest Academy at Aschaffenburg should be given up, and arrangement be made for instruction in forest science and forestry being given in connection with the University of Munich, stating the motive by which he was led to the decision; and, in doing this, he subjects the historical development of forest institutions in Bavaria to an exhaustive criticism.

The arguments pro and con are stated at great length in the *Denkschrift Betreffend den Forstlichen Unterricht in Bayern* already cited, the result ultimately was the arrangement at present existent—a Forest School at Aschaffenburg, with the theoretic and advanced studies prosecuted in the University, with attendance at the station for experimental researches, in a royal order of 21st August, 1881, is enjoined.

Par. 1. In the Bavarian State forest service there will only be received as candidates for admission such as possess a certificate of having passed through the whole course of study at the forest institute at Aschaffenburg, and the final examination in theoretic forestry in the University of Munich, with the State examination in practical forestry with satisfaction.

Par. 2. The institute of forest instruction at Aschaffenburg has the function of preparing young men who desire to give themselves to the Bavarian forest service, in the fundamental and accessory sciences, so far as may be necessary to qualify them for pursuing an exhaustive study

of forest science in a University, and in the forestal experimental institute in Munich, besides which the forest institute in Aschaffenburg offers an opportunity to students for pursuing the study of forest science with other designs than that of entering the forest service of Bavaria.

Par. 3. The forest institute is immediately under the control of the Minister of Finance, and the Minister of Religion and Education.

The staff of teachers comprises:—

Par. 1. The Director, who, as principal of the institution, has to take the direction of the instruction taking part in this according to directions from the Ministers of State entrusted with the charge of the institution.

Par. 2. The Royal Oberforster of the Kleinstheim district, who has his residence in Aschaffenburg, whose subjects of instruction are also determined by the Ministers named.

3. A professor of physics and of mensuration.

4. A professor or tutor for mathematics.

5. A professor of botany.

6. A professor of zoology.

7. A professor of chemistry and mineralogy.

8. An assistant in management, who is also teacher of chart-drawing and librarian. Besides the teaching staff there is a house steward, whose functions are specified in special instructions relative to service.

Par. 9. Students who do not desire to enter the Bavarian forest service may be received as *Hospitanten* into the forest institute. These must bring certificates of good character, and prove that they have such education as will enable them to understand the lectures given. They may obtain certificates of satisfactory attendance on the entire course, or of attendance and proficiency in particular departments; but these certificates are not available for their admittance into the Bavarian forest service.

Par. 11. Aspirants for employment in the Bavarian State forest service, possessing a complete certificate from the Forest Institute at Aschaffenburg, must continue their studies for at least two years at a German Univer-

sity, and must attend one year at least at the practical exercises in the forestal experimental research station at Munich. This attendance may be given during the last year of their attendance at the University.

Par. 14. There shall be held every year in the University of Munich a concluding final examination on theoretic forestry, to which can be admitted only such students as possess a complete certificate from Aschaffenburg, and have met the requirements of par. 11 of this order. The requirements in regard to these examinations will be determined by the Ministers of State for Religion and Education, and for Finance.

Candidates who have passed this examination satisfactorily shall receive a final certificate of their having passed the whole of the professional studies, with a declaration of their competency to enter on the practical work of the State forest service. Candidates who have not been declared fitted for this may present themselves yet again for examination, but only after at the least one year, and at the most two years study at the University, such students may also be required again to attend the forest experiment institute at Munich, and that for at least a complete session. There may be admitted to these examinations students at the University of Munich who do not contemplate aspiring to the State forest service of Bavaria. These will receive a certificate of the result of this examination; but this confers no right to enter the Bavarian forest service.

By *Bekanntmachung*, or proclamation by the Ministers of State, under date of 10th November, 1881, were specified details of the arrangements thus made necessary.

As originally in the University of Giessen the instruction in forestry were given in connection with the faculty of political economy, a similar arrangement has been adopted in the University of Munich. According to the published *Verzeichniss*, or programme of lectures in the Ludwig-Maximilian's University, for the winter session of 1884-85, five lectures, or more strictly speaking five hours of

lectures on sylviculture and forest conservation were given weekly; 4 hours lectures on earth and the chemistry of these; 3 hours on natural laws regulating agriculture and sylviculture, with practical work in the forestal chemistry laboratory; 4 hours on the measurement of wood with practical exercises in the art; 3 hours on Saturday in forest surveying; 4 hours in forestal calculations in connection with forest statistics; 4 hours structure and physiology of plants with microscope demonstrations; 3 hours public practice in use of the microscope, daily private practice in use of the microscope; 5 hours State forest science, and 3 hours history of forestry. And according to the programme of lectures for the summer session of 1885 there were given 5 hours a week to lectures on forest exploitation and forest technology; 1 hour to conservation of forests and woods, with excursions and demonstrations on specified days; 4 hours climatology and meteorology, with introduction to meteorological observations; 3 hours chemistry of plants with regard to forestal and rural economy; 2 hours to forest statistics in rentability or pecuniary returns from forests, with excursions and practice in valuation of trees and all forest produce on certain specified days; 3 hours forest culture plants; 3 hours vegetable pathology with botanical instructions; 5 hours forest administration, with practical exercise on specified days; 2 hours road-making and laying out of land, with practical exercises on specified days; land surveying 3 hours, with practical exercise on specified days; 2 hours forestal policy, and means of transport in relation to private and political economy.

The latest information at my command in regard to instruction in forestry in Bavaria is contained in a paper by Dr Tuisko Lorey, Professor of Forest Science in the University of Tübingen, On forestal instruction, and forestal experimental research, in a handbook of Forest Science edited by him. In this it is stated that the latest directions are contained in the *Finance ministerialblatten* of 17th November, 1881, under the heading of royal order

relative to forestal instruction 21, VIII. 81 ; and in a proclamation relative to examinations in the University, relative to practical examinations and relative to praxis of 16th November, 1881.

Aspirants to the forest service are educated and instructed in the forest institute at Aschaffenburg, and in the University of Munich, and as has been appointed since 1878: first two years, or four sessions, being spent in study at Aschaffenburg, and the result of this being shown by an examination. This is followed by two years' study at the University, concluding with an examination in Munich ; of this latter time spent in Munich at least one year must be spent in attendance on practical work in forestal experimental work. The requirements for admission and *Maturitäts Zeugnis*, or exit certificate, from a gymnasium or *real-schule* of the forest order.

In the forest educational institute at Aschaffenburg, which is under the immediate supervision of the division of the Minister of the Interior relative to church and school affairs, and the Minister of Finance, the object, in so far as the royal Bavaria State forest service is concerned, is to impart the preparatory instruction in the foundation and professional sciences requisite to fit for profitable attendance at the University. In view of this the instruction embraces elementary mathematics ; in the higher mathematics, the analytical geometry of plane surfaces, and the elements of differential and integral calculus ; inorganic and organic chemistry, mineralogy, botany, zoology, mensuration, and chart drawing ; in like manner, in regard to forestry, primary instruction in silviculture and in *extenso* forest protection, the science of the chase and road-making. Of teachers there are in all eight. Along with the director, a second docent of forest science, who is also manager of the attached forest instruction *revier*, or district of Kleiostheim, one for physics and mensuration, one for botany, one for zoology, one for chemistry and mineralogy, one for mathematics, one for chart-drawing. For chemistry there is also an assistant,

In the University of Munich, which is under the immediate supervision of the Minister of the Interior for church and school affairs, the forestal experiment institute connected with the University is under the Minister of Finance. The professional instruction, in so far as this is not completed at Aschaffenburg, is given; \* and with this the study of political economy and jurisprudence is attended to. All the branches are treated of every year. Forest science is comprised in the faculty of political economy.

Specially adapted to forestal studies are six regular professorships, four of which are specially forestal, with one for forest botany and one for forest soil, climatology, &c. All the holders of these belong to that faculty. In consequence of excellent railway connections, the excursion district is very extensive and instructive. † The exit examination is held yearly. It is exclusively oral; and it embraces all the branches, the study of which is not completed at Aschaffenburg. The examination commission consists, under the presidency of a high State forest official, of teachers from the University, and occasionally from the technical *Hochschule* for particular accessory sciences.

The number of students of forest economy in the summer session of 1885 was 92; and in the winter of 1885-86, 94; of whom respectively 36 and 41 were not Bavarian subjects.

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\* Several of the studies included in the Aschaffenburg programme, such as road-making and mensuration, are also treated of in Munich, but this is done principally in the interest of forest managers who are not Bavarian subjects.

† There is an excellent article by Gayer, on the excursion district of Munich in the *Forstwissenschaftliches Centralblatt*, for 1880, p. 73, and 1881, p. 1.

## CHAPTER VII.

### ROYAL WURTEMBERG FORESTAL AND AGRICULTURAL ACADEMY AT HOHENHEIM, AND FORESTAL IN- STRUCTION IN THE UNIVERSITY OF TUBINGEN.

IN the history of the Schools of Forestry at Giessen in Hesse Darmstadt, and Aschaffenburg and Munich in Bavaria, we meet with different phases of the evolution, or development of such institutions, issuing in their incorporation in the National Universities. In the kingdom of Wurtemberg we meet with another different phase of similar transformation.

Until within a few years ago, the study of forest science in Wurtemberg was provided for in the Royal Wurtemberg Academy of Land and Forest Economy at Hohenheim, about 11 *kilometers* distant from Stuttgart, the capital of the kingdom, and near to the Wurtemberg forest.

Hohenheim was formerly a Grand Ducal country residence, with numerous out-buildings attached. It is situated on the high level plateau of Fildes, 390 meters above the level of the sea, and 140 meters above the level of the vale of Stuttgart. The inhabitants, inclusive of the students, numbered in 1880 about 300. The number of families was 30.

The palace buildings, with wings and out-buildings, contain about 100 apartments for the accommodation of students.

In 1818 there were founded there two separate Academies: an agricultural one and a forestal one. In June, 1820, these were united; and the combined schools were re-organised September 9th, 1865.

From an official publication entitled *Übersicht über die Organisation, die Zwecke, den Lehrplan, die Lehrmittel, Aufnahmebedingungen und sonstigen Verhältnisse der K. Württemb. Land- und Forstwirtschaftlichen Akademie Hohenheim*, it appears that the Royal Wurtemberg Academy of Land and Forest Economy at Hohenheim is a palatial edifice, and is supplied with all the requisites for the study of rural economy, agriculture, and forestry; it is surrounded with grounds of considerable extent, including experimental and botanic gardens; and is supplied with other facilities for the study of practical operations. Instruction was at that time communicated by lectures, exercises, excursions, and experimental work.

The curriculum extended over two years, divided into four sessions, one commencing on October 15th, and closing on 9th March, the other commencing on 1st of April, and closing on 15th of August, and this was followed by a vacation of two months.

There were three distinct departments of study—*Landwirtschaftliche Disciplinen*, embracing what relates to agriculture and rural economy; *Forst-wirtschaftliche Disciplinen*, embracing what relates to the treatment of forests; and *Grund- und Hilfs-wissenschaften*, or fundamental and accessory sciences; and the arrangements were such that students could avail themselves of the provision for instruction in either the one or the other of the two first-mentioned branches of study, or to the full extent of the provision for instruction in one, and to some extent partially of the provision for instruction in the other,—and in many of these cases with or without availing themselves of the provision made for instruction in the fundamental and accessory sciences.

The subjects of study were the following, the order in which they were studied being definitely determined by provision for the convenience of the professors and students.

I. Rural economy.

A History and literature of rural economy.



*B* Agricultural and rural productions. General doctrine in regards to agricultural productions, and to the reclaiming and drainage of land.

*a* Agricultural implements and machines. *b* Special doctrine in regard to cereals and similar products. In addition to which, in the concluding session, special lectures were given on the growth and the production of hops and of tobacco; on lime-making; on the culture of fruit trees; and on the culture of culinary vegetables. *c* General doctrine in regard to the rearing of animals, with application of the same to the breeding of sheep and preparation of wool; and in the last session special instruction was given in regard to the breeding of horses, of oxen, and of small cattle, on silk-culture, and on the keeping of bees.

*C* Rural economy.

*a* Treatment and disposal of economical products. *b* Valuations, estimates, and exercises in drawing out schemes of operation. *c* Bookkeeping.

*D* Technology of rural economy.

In connection with these series of lectures there were given appropriate illustrations in the collections of models, of implements and of machines, in the museums of wood and of soils, in the experimental fields, in the nurseries and arboretum and different gardens, in the cattle-folds and in the workshops of the institution, together with practical exercises in making valuations, estimates, and schemes of exploitation, excursions, &c., &c.

II. Forest economy.

*A* Encyclopædic view of forest economy, with a special reference to the study by students of rural economy of allied subjects in this department.

*B* History and literature of forest economy.

*C* Forest products.

*a* Forest botany. *b* Sylviculture. *c* Forest protection. *d* Technical properties of timber. *e* Uses of forests; and forest technology.

*D* Forest economy.

*a* Mensuration of trees and forests. *b* Partition of forests for exploitation. *c* Valuation of forests. *d* Practical management of forests.

*E* Administration of Crown forests. A special introductory lecture on the subject and exposition of the forest laws of the kingdom of Wurtemberg.

*F* Encyclopædic view of rural economy for the instruction of foresters.

In connection with these series of lectures there were given, in occasional extensive, and in regular less extensive excursions, &c., similar to those connected with instruction in rural economy, appropriate demonstrations in different forest districts, in the Botanical Garden and Museum of Forest Products, and practical exercises in the calculation of cubic measurement of trees, and cubic contents of woods, and in the laying out of forests for exploitation.

### III. Fundamental and accessory sciences.

*A* Political economy.

*B* Agriculture.

*C* Jurisprudence. Legislation in regard to Wurtemberg forest management; legislation in regard to rural economy.

*D* Mathematics—arithmetic, algebra, plane geometry, geometry of solids, trigonometry, practical application of geometry. In connection with this there was regular practice in land surveying and levelling, and in the mensuration of forests with the theodolite.

*E* Physical science—experimental natural philosophy; meteorology; experimental chemistry; agricultural chemistry; production of fodder; physical geography; geology; technical mineralogy; botany; anatomy and physiology of plants; diseases of plants; special botany; anatomy and physiology of domestic animals; zoology; special zoology; introduction to the use of the microscope. In connection with these studies there were practice in the chemical laboratory, demonstrations in the botanical museum and garden, and in the experimental fields of

the rural economy experimental farm, and regular botanical and geological excursions, &c.

*F* Veterinary science.

*a* Materia medica and formulas of recipes. *b* Pathology and therapeutics of domestic animals. *c* Special lectures on epidemics. Veterinary assistance in the birth of animals. *d* Theory of shoeing.

*G* Technical arts—rural architecture, preparation of plans.

Besides these, from time to time lectures were given on general science, and on subjects connected therewith.

The regular course of study of forest economy extended over two years; but every year the lectures were attended by amateur students or others, who were not required to go through the whole course; and the director was always ready, as were also the collective body of instructors, to aid such in determining how long they should remain, and what classes they should attend, with a view to making the most of the time they could spend there.

Of all students applying for admission there were required—

1. Certificates that they were above eighteen years of age; but in rare exceptional cases, by special resolution of the *Senatus Academicus*, youths who had not completed the eighteenth year of their age might be admitted.

2. Certificate in regard to previous course of study. In case of the applicant having previously studied at the University, or other superior educational institution, there was required a regular certificate of disjunction from the officials of the college.

3. In case of the applicant, according to the law of his domicile not being of age, a certificate from his parents or guardians of their consent to his joining the Academy, or otherwise residence of his being independent and free to act for himself.

4. Subscription to obligation to conform to the statutes issued for behaviour of students in the Academy, a printed copy of which was supplied to every student.

Foreigners were further required to produce a passport, or a ticket of legitimation from the proper authorities.

From students of forestry designed for the forest service of the State, in accordance with Royal Ordinance of 20th January, 1868: *In Betreff der Forstdiens-prüfung*, and order of the *R. Ministerium des Kirchen, und Schul-wesens* of the 19th June, 1873, in regard to the *Maturitäts-prüfung*, there was required, in addition to what has been stated, a certificate of having passed an examination of qualification for entrance on advanced studies.

And from students of forestry who had no view to entering the forest service of the State there was required, as is required of the students of rural economy, satisfactory testimony of their possessing the scholarship and training necessary for profitably availing themselves of the instructions given in the Academy. When they did not already possess a certificate of graduation, or diploma indicative of their attainments, this might be obtained in connection with their attendance at the Academy, which was valid as a qualification for the same.

Others than students, gentlemen whose views were to make themselves acquainted with the discipline and teaching in the Academy or other institutions at Hohenheim, might remain as *Hospitanten*. The admission of such, as a rule, did not take place at the commencement of a session, but some six or more weeks thereafter, and the stay of such as *Hospitanten* was limited to four weeks.

In case of students having to leave the Academy, at least fourteen days notice had to be given of their intention, excepting in admitted cases of necessity.

On regular departure from the Academy, a certificate, in a prescribed form, was given to any student, stating the time he had spent in the Academy, the lectures he had attended, the character of his behaviour, and if he deserved it, the diligence with which he had prosecuted his studies.

Diplomas were granted at the close of their course to students of rural economy, but some attended only a short period. To these, and to students of forest economy, an

opportunity was given at the close of each session, by written exercises and *viva voce* examinations, to obtain certificates in regard to their attainments in such of the branches of study as they might desire

Prizes also were offered as encouragements to study, and the fact of one or more prizes having been taken relieved the student of the necessity to prepare written exercises while under examination for his diploma.

A certificate in regard to his attainments could be obtained by the student only in the form of one or more of the certificates given after examination, at the close of each session: and only in the case of his having submitted to one or more of these examinations. On special application a student might, while pursuing his studies in the Academy, obtain an interim certificate in regard to his diligence and behaviour.

In case of any student being expelled, the fees, &c., paid were not returned. This was also the case if permission to leave in the course of a session were applied for and granted. But in case of sickness, or of a summons to military service, on special application, the fees, &c., in question were re-paid.

For lodging, instruction, and the management of the institution, students of rural economy, if subjects of Wurtemberg, pay 180 marks (£9) per annum; if foreigners, they pay 500 marks (£25) the first year, and 350 marks (£17 10s) the second. Students of forest economy, if subjects of Wurtemberg, paid also 180 marks (£9) per annum; if foreigners, 350 marks (£17 10s) each year; and by paying extra fees these latter might also attend classes connected more immediately with rural economy, which did not come within the range of their prescribed studies.

*Hospitanten*, who are subjects of Wurtemberg, pay for the use of an apartment one mark a day; but they have to provide their own bed and bedding, and they are free to attend all lectures, and avail themselves of all the means of instruction offered by the Academy. *Hospitanten*

ten who are foreigners have the same liberty, and they are provided with bed and bedding, for which, and the use of the apartment, they are charged two marks a day. Each of the students has a furnished room, and those who are foreigners are supplied with bed, bedding, and towels; these three requisites students, subjects of Württemberg, provide for themselves. Arrangements may be made for the occupation of better rooms, or for living outside the Academy: these I need not detail. In regard to food each student may make his own arrangements. He may dine outside, or at the college table. The average expense of board is about two marks a day. Those who board in the Academy lodge with the house steward, and pay 140 marks at the beginning of each session, from which is deducted monthly the amount of their monthly bill.

It is made a special condition of the appointment of the house steward that he, on due remuneration, must provide food for sick students, whether they take their food daily from him or not, and to prepare either such food as they themselves may desire, or such as may be prescribed by their medical attendant, preparing it well, and serving it either in their own room, or in the hospital of the Academy, as occasion may require.

Amongst the numerous provisions for facilitating study at the Academy of Hohenheim, many of which relate more especially to agriculture and rural economy, there is a forest district of about 2,200 hectares or 5,500 acres, partly composed of Crown forests and partly of communal forests, embracing different kinds of soil, different forms of management, and different modes of culture, which were under the direction of one of the two professors of forest economy; and besides this *Forstreiver*, there are others in the vicinity of Hohenheim, to which access was had, and also an arboricultural experimental garden.

There is a botanic garden of  $4\frac{1}{2}$  hectares or  $12\frac{1}{4}$  acres, with some 2000 species and varieties of plants of importance in forest and in naval economy; and a so-called

exotic garden of about 8 hectares or 20 acres, laid out with a special view to instruction in forest botany.

There is a collection of models of implements, machines and structures pertaining to forest economy; a museum of forest products, and one of forest manufactures, &c. Some of the models are of full size and in working order, others are in section, or constructed on a reduced scale.

A mineralogical cabinet, with a collection of geological formations and fossils employed in illustration of lectures, contains about 14,000 specimens.

A botanical museum contains different herbaria, numbering conjointly 10,000 species, with several specimens of many, and a collection of numerous microscopic preparations, a collection of vegetable pathological specimens illustrative of diseased malformation, also many models of flowers, fruits, furze, &c., and finally a collection of some 7000 specimens of fruits and seeds. There is a chemical laboratory, with 16 double stations for students, provided with all the necessary appliances for work. A cabinet of natural philosophy containing instruments and apparatus required for instruction of the students in mathematics, mensuration, and natural philosophy. A library containing about 10,000 volumes, open to the use of the students. An experimental forest station, with experimental garden, and a station for making and recording meteorological observations. For the use of the chemical laboratory and chemical agents a charge of eight marks, or eight shillings, per session, is made to the students of practical chemistry.

There is also a reading-room provided with newspapers and periodicals, for the purchase of which a charge of four marks each session is made.

An account of this Academy at Hohenheim is given in detail in a publication relating to the meeting of German agriculturists and foresters at Stuttgart in 1842, under the title of *Die Königliche Würtembergische-Lehranstalt für Land-und Forstwirthschaftliche Akademie, Hohen-*

*heim*, and in the published account of the semi-centennial celebration of the institution, held 20th November, 1868, under the special title of *Geschichtliches über die Lund- und Forstwirthschaftliche Akademie. Hohenheim, von Professor Dr V. Fleischer*. A concise notice is also given in a pamphlet prepared for the Vienna Exhibition of 1873, *Der Höhere Landwirthschaftliche Unterricht in Wurtemberg*, by Professor Walter Funke.

Professor Mathieu, of Nancy, in describing this institution, in *Revue des Eaux et Forêts*, 1874, says: - 'The little kingdom of Wurtemberg, with scarcely two millions of inhabitants, has spared nothing in providing it with whatever could contribute to the success of instruction or to the progress of science. This truly liberal spirit has led to the establishment of magnificent agricultural galleries, where we find collected to the number of sixteen hundred the various tools and machines employed in labours of the field; elegant rooms filled with forestal collections, implements, woods, and various products; cabinets in botany, zoology, mineralogy, and geology; instruments for use in studies of physics and for geodesy; a station for experiments concerning woods, and another for meteorology. Its library numbers 5,500 volumes, and its reading-room contains numerous periodicals in all languages, of which 49 were scientific, agricultural, or forestal journals, and thirty-five were of the political, literary, or illustrated class.'

It has been reported in a preceding chapter, relating to the Royal Saxon Forest Academy at Tharand, that after existing for a lengthened period as a school exclusively devoted to instruction in forestry, there was introduced into the Academy a School of Agriculture or Rural Economy; that the two were after a time combined; but that afterwards the two were dissevered, and the Academy again restored to its primal condition of an exclusively Forest Academy. In Hohenheim the School of Forestry, originally an independent institution, was likewise brought into combination with a School of Agriculture; and here,



too, a severance has been effected. And again, in Wurtemberg, as in Hesse Darmstadt, there existed formerly in the National University of Tubingen provision for the study of forestry. Of this the late Dr Hough of the United States forestry section of the Department of Agriculture has reported :—

‘Since 1817 the University of Tubingen has had a Chair of Agriculture and Forestry in its faculty for State economy. It has for its object to furnish students with the knowledge necessary for employment in financial and administrative affairs, and therefore only the more important points of information are presented in the lectures, but they penetrate deeper into the spirit of the different systems of agricultural and forestal economy, with the view of pointing out the motives concerned, and in this manner of rendering their relations to financial matters and to the public interests more fully understood.

‘This course of instruction presents little of interest in the practical business of the forester, as compared with the abundant facilities and broad plan of education afforded at the school at Hohenheim. Many of the students of the latter find it, however, to their advantage to attend for some time the lectures of the University for the purpose of gaining a fuller knowledge of the auxiliary sciences.’

Towards the close of 1880 arrangements were under contemplation to combine the School of Forestry with the University as an integral part of the same; and in due time these being completed, the change was made.

Amongst the reasons for this were the following :— Formerly there were two classes of foresters; one of which studied administration and law, besides the usual professional course of study relating to the management of forests; while the other confined their studies to these: mathematics, physical sciences, and forestry. But after a time this second class almost disappeared in consequence of the limited prospect they had for their future, and

almost all the young foresters, after having passed their exit examination, went to study at the University.

As there was nowhere a complete curriculum of forestry excepting at the University of Munich, the young Wurtemberg foresters went to Munich, studied there, and only took at Hohenheim their final professional studies, while the different education of the young agriculturists, and of the majority of the young foresters, also occasioned difficulties. This state of things could not last, and in course of time the study of forestry was transferred to the University at Tubingen, and at Hohenheim was continued the Agricultural Academy. Forstrath Professor Dr Nordlinger wrote to me two years and more after the change had been made:—‘We have now more than forty students of forestry, while at Hohenheim we had not more than twenty. Instead of having two professors ordinary we have but one professor extraordinary, which suffices for the accessory and foundation sciences. Our students of sylviculture sit alongside the medical and other students. In a word we constitute an integral part of the University without being an institution apart; our collections, and our exercise ground, and forest arboretum, are the only exception to this.

‘Tubingen is exceptionally well situated forestally. We find ourselves on the confines of the most extensive and most interesting forests of the country—the Black Forest, Schoenbuch, the White Forest of Swabia, &c.’

Subsequent experience justified the expectations which had been entertained of good being likely to be the consequence of the change, one result of which is that the number of students has now risen from less than twenty at Hohenheim to upwards of fifty at Tubingen; and the staff of professors of forestry has been increased, from which other benefits have flowed. Unlike what has generally been the case in other countries on the Continent of Europe, in which the whole body of forest officials are educated upon the same principle, though not to the same extent, this being secured by requiring them

to be educated at national institutions in Wurtemberg, previous to this change, while the necessity for a higher education in men occupying the higher positions in the service was recognised, there was no national provision for this being given; aspirants were accordingly allowed to procure this where they might or where they choose—it was enough that it was acquired. From this there resulted a risk of want of unity and uniformity in the views and plans of those who had the administration and superior management of the State forests. This was less likely to occur now than previously; and the advantage of a knowledge of what was being done in the forests of other and adjacent countries could be secured by forest excursions.

At the Academy at Hohenheim it was found, as has been intimated, that the preliminary or preparatory studies required in the two departments—forestry and rural economy—did not always accord. To the students of the former mathematics was absolutely necessary; while to the latter, valuable as might be the educational effects of the study of mathematics, these were not requisite as a practical preparation for rural economy, and arrangements required in the interests of the one body of students came occasionally into collision with the arrangement required in the interests of the other: this was now avoided.

Moreover, the advantage of general culture, the importance of which has been more and more recognised of late years, had facilities for this being acquired presented by the University greatly in excess of those offered by Hohenheim—University associations tending to expand the mind; while the general tendency of a special school is understood to be to impair the general development of the intellectual and moral faculties. In the programme of lectures in the University of Tubingen for the winter session of 1885-86 there are specified upwards of two hundred different classes, to any or all of which, in accordance with arrangements in Universities in Ger-

many, the students have access to an extent unknown in our Scottish Universities; and a greater number of classes, upwards of two hundred and twenty, were open to them in the same measure in the summer of 1886.

The studies are arranged as pertaining to one or other of seven faculties: evangelical theology, catholic theology, law, medicine, philosophy, political economy, and physical science. And there are classes for instruction in riding, rifle shooting and fencing, gymnastics, dancing, music, and drawing. There are also forty University institutes or educational appliances, inclusive of the University library; the Hoffman library for exercises and discussions in political economy, in the faculty of which forestry is included; forest museum; museum of forestal and rural economy; station for forestal experimental research; workshop of forest technology; technological museum; botanic museum; botanic garden; and museums and laboratories of various kinds, pertaining to the study of different departments of physical science.

In the University forestry pertains to the faculty of political economy, with classes for instruction in matters more immediately or more remotely connected therewith. As pertaining to this faculty there are classes for the study of the following subjects, which are strictly forestal: cyclopædia of forest science; forest botany; silviculture: forest management applicable to trees of different kinds; forest protection and conservation; forest exploitation; forest valuation and forest statistics; forest economy appropriate to State forests; forest technology; forest road making; structure, physiology, and histology of trees, and in the classes of the faculty of physical science are all the fundamental and accessory sciences generally included in what is considered as complete course of instruction in forestry and forest science.

In regard to forestal instruction in Wurtemberg, Dr Tuisko Lorey, professor of forest science in the University of Tubingen, reports:—‘The existing arrangements are determined by order of 30th October, 1882, and order of

7th October, 1885; the instruction is, under the supervision of the Minister of Ecclesiastical and Educational affairs, imparted in the University of Tubingen. All professional subjects, with the exception of road-making and the chase, are subjects of prelection every year, as are also all the foundation and accessory studies, which are treated fully in the University. Forest Science is included in the faculty of political economy. The pre-requisites to admission to study are an exit certificate of some Latin gymnasium, or of a Wurtemberger's *real-gymnasium*.'

An appointed period of study for aspirants to the State forest service is as definitely specified as is the place of study. The average of the latest promotions gives a period of from seven to eight sessions. The examinations are twofold :—*A.* An entrance examination held twice a year in Tubingen by professors, in the presence of a commissioner of the government. It embraces mathematics; elementary mathematics, and analytic plane geometry; mensuration and levelling, with drawing of charts; physics, chemistry, botany, zoology, and geology. And *B.* First forest service examination, held twice a year in Tubingen, in presence of a commissioner, like as is the case with the entrance or preliminary examination, which embraces forest discipline, national economy, and jurisprudence. To conduct the studies in forest science there are two ordinary and one extraordinary professors. There is no forest *revier* or district appropriated for use in instruction; but the vicinity is rich in forests presenting in this respect great variety and good opportunities for excursions and demonstrations.

An account of the vicinity in respect of forests is given in a paper by Dr Lorey in the *Allgemeine Fort Blatter* for 1882, entitled the Excursion Region of the University of Tubingen.

The number of students in the summer session of 1885 was 16, and in the winter session 1885-86, 26, of whom respectively 2 and 8 were not Wurtembergers.

## CHAPTER VIII.

### FORESTAL INSTRUCTION IN THE GRAND DUCHY OF BADEN IN THE POLYTECHNICUM IN CARLSRUHE.

IN Tharand, Neustadt-Eberswalde, Hanover, and Eisenach, we have what may be characterised as the germ—the forest school—developed into the Forest Academy, Forestal School or School of Forestry. In Giessen, in Bavaria, and Wurtemberg, we have the School of Forestry transformed into a section of the National University. In Baden we meet with yet another phase of development—the School of Forestry taking its place *ab initio* as a section of a Polytechnicum, which has also been the case elsewhere. This educational institution was established in 1832; and in 1834 Dr Klauprecht, who had been associated with Hundeshagen and his successors in giving instruction in forestry in Giessen, was called to take charge of forestal instruction in the Polytechnicum in Carlsruhe. It was established with a view to the development and diffusion of technical science and art; and the instruction given is based on the principle that a thorough preparation for any technical calling must be founded on a *Mathematischer, natur-wissenschaftlicher, wirthschaftswissenschaftlicher, historischer, und künstlicher Bildung*, or an education in accordance with mathematics, science, the economical application of these and of art, and a correct acquaintance with history.

It supplies to the engineer, the mechanic, the architect, the chemist, and the forester, opportunities for acquiring education and instruction in general, and in special sciences and arts; while the financier, the pharmacist, the land surveyor, the teacher of mathematics, and of natural history, and all who have devoted themselves to

other industrial occupations than those named, may find in attendance at it appropriate instruction ; and students of pharmacy have the option of attending either the Polytechnicum or the University, as a pre-requisite to examination. The instruction required for different industrial occupations is arranged in accordance with the following divisions:—

1. The School of Mathematics. 2 The School of Engineering. 3. The School of Machinery. 4. The School of Architecture. 5. The School of Chemistry. 6. The School of Forestry. The method of instruction takes the form of lectures, examinations, practice in drawing and in construction, work in the laboratories and workshops, and excursions. Combined with the Polytechnicum are the following collections by which instruction is aided and sustained :—

1. A cabinet of philosophical instruments. 2, A geological and mineral collection. 3. A zoological and botanical collection. 4. A collection of models belonging to the School of Engineering. 5. A collection of models belonging to the School of Machinery. 6. A collection of models belonging to the School of Architecture. 7. A technological collection. 8. A collection of instruments used in land surveying, &c. 9. A collection of models for use in teaching geometry. 10. A collection of plaster casts. 11. A collection of objects connected with forests. 12. A library and reading-room of science connected therewith.

There are also laboratories—(1) a chemical laboratory ; (2) a laboratory of natural philosophy ; (3) a mineral laboratory ; (4) a laboratory of organic chemistry ; (5) a laboratory of technological chemistry.

Further :— there is an arboretum, or forest garden ;

And finally, workshops :—(1) for making models in clay ; (2) for making models in plaster-of-Paris ; and (3) for making models in wood.

The Polytechnicum is under the immediate control of the Minister of the Interior, and is governed by a director appointed annually by the Sovereign, on the ground of his

election by the professors; a petit council, consisting of the director, his predecessor in office, and three others, elected and appointed annually in the same way; and the grand council, consisting of the collective body of ordinary professors.

The body of instructors, consisting of professors, lecturers, college tutors, and assistants, numbers forty-nine in all.

There are two sessions in the year: the winter session is from the 1st of October to the 15th March; the summer session from the 15th of April to the 31st July; and provision is made for profitably employing the holidays and vacations in excursions or tours of observation, with or without the assistance of professors.

In illustration of the advantages of combining a School of Forestry with other educational arrangements, I may state that there are only two professors of forest science in the Polytechnicum at Carlsruhe. Most of the classes not taught by them attended by students of forestry are classes taught in some of the other schools or faculties of the institution. The exceptions are that the Professor of Economics has a special meeting with the students of forestry one hour a week during the summer session, and the Professor of Rural Economy in the University of Heidelberg has a meeting with them for two hours once a week both summer and winter.

Where it is desirable to minimize as much as possible the staff of teachers, much may be effected by substituting for several separate professorships one of Economic Botany and Forest Economy.

The requirements for admission are as follows: citizens of the State, who wish to enter the State forestry service, after attending a full course at the gymnasium, are admitted, and must pass through a course of four years, of which the first two are devoted to those fundamental and auxiliary studies which do not relate directly to forest science, but which serve as a preparation for the remaining two which embrace the forest course proper. Foreigners may attend the first two years or not, as they prefer.



The least age of admission is 17 years. At the close of the second year the State students must pass an examination in natural philosophy and mathematics, and if they fail they are allowed one more trial. This examination entitles them to enter upon the last two years of special forest studies in which they are taught agriculture, forest jurisprudence, and the higher mathematics, when they are again examined, and if passed, are qualified for a place in the State service. The examination at the end of the first two years is by the professors of the polytechnic school, and the final one by the forest directors, a person skilled in law, a professor of agriculture, one of forest management, and two professors of mathematics.

'After passing all examinations the candidate is assigned to the general district foresters as an assistant, to enable him to become practically acquainted with his duties, and he receives a tract of forest to manage. After six to ten years, according to the number waiting, he gets a position as general district forester. The number of these districts in Baden is at present 110, and about four of these appointments are made annually. The Forestry Direction has its seat in Karlsruhe, and is composed of six members, who are inspectors.'

The following were the arrangements for study in the School of Forestry during the sessions from 1st October, 1876, to 31st July, 1877:—

#### STUDENTS OF THE FIRST YEAR—WINTER SESSION.

Geometry of solids, 3 hours per week ; drawing of plans and diagrams, 2 hours ; botany: morphology, physiology, and cryptogamic plants, 3 hours ; experimental physics, 4 hours ; repetitorium of the same with the assistant, 1 hour ; experimental organic chemistry, 4 hours ; conversational examination on the same, 1 hour ; freehand drawing, 2 hours.

#### SUMMER SESSION.

Arithmetic, 3 hours per week ; drawing of plans and

diagrams, 2 hours; botany: special natural history of phanerogamic plants, 3 hours; botanical excursions and practice in determining plants, from two to three half days; experimental physics, 4 hours; repetitorium of the same with the assistant, 1 hour; organic experimental chemistry, 4 hours; qualitative chemical analysis, 2 hours; work in chemical laboratory, 5 hours; freehand drawing, 4 hours.

#### STUDENTS OF THE SECOND YEAR—WINTER SESSION.

Plane and spherical trigonometry, 2 hours per week; analytical geometry of planes, 3 hours; drawing of plans, 2 hours; practice in the handling and use of instruments used in land surveying, &c., 4 hours; mineralogy, 4 hours; practice in mineralogy, 3 hours; vegetable physiology, 3 hours; use of microscope, 2 hours; zoology: general zoology and special natural history of vertebrata, 3 hours; work in chemical laboratory, 5 hours.

#### SUMMER SESSION.

Drawing of plans, 2 hours; geology, 4 hours; practice in mineralogy, 3 hours; practice in agricultural chemistry and vegetable physiology, 9 hours; geographical distribution of plants, 1 hour; zoology: natural history of invertebrata, 3 hours.

#### STUDENTS OF THE THIRD YEAR—WINTER SESSION.

Differential and integral calculus, 4 hours; practical geometry, 3 hours; forest improvement and technology, 4 hours; forest protection, 4 hours; forest soils and climatology, 2 hours; forest excursions and practical exercises, Saturdays—encyclopædic study of rural economy, 2 hours; political economy, 4 hours.

#### SUMMER SESSION.

Elements of mechanics, 5 hours; exercises in practical geometry, afternoons; agricultural chemistry, 2 hours; forest exploitation and history of forest economy, 5 hours; natural history of forest trees, 3 hours; forest excursion, and practical exercises, Saturdays; encyclopædic study of

rural economy, 2 hours; financial science, 3 hours  
history of the German forest police, 1 hour.

#### STUDENTS OF THE FOURTH YEAR—WINTER SESSION.

Forest policy, 3 hours; taking up of trees, means of growth, and management of forests, 6 hours; excursions in woods and forests, with a view to the establishment and completion of the lectures on the subjects mentioned, Saturdays and free afternoons; forest roads and hydraulic engineering, 3 hours; encyclopædic study of rural economy, 2 hours; popular study of law, 3 hours.

#### SUMMER SESSION.

Forest engineering and history of forest science, 5 hours; history of the German forest policy, 1 hour; pecuniary valuation of forests, 3 hours; forest police, 2 hours; forest statistics, 2 hours; forest administration and management, 2 hours; encyclopædic study of rural economy, 2 hours; forest and game laws, 2 hours; excursions in woods and forests, with a view to the establishment and completion of the lectures on all the subjects mentioned above, Saturdays and free afternoons.

To students in the forest school there is recommended, moreover, attendance in the following classes:—

#### WINTER SESSION.

Modern history, more especially of Germany since 1816, 4 hours; modern history of German literature since the death of Schiller, 2 hours; hygiene, or preservation of health; anthropological introduction and domestic hygiene, 2 hours.

#### SUMMER SESSION.

Roman history, 4 hours; Lessing's *Nathan der Weise*, 1 hour; public hygiene, or preservation of health, 2 hours.

The arrangements in regard to admittance, fees, diplomas, holidays, &c., and in regard to hospitanten are similar to those in the Agricultural and Forest College at Hohenheim, though varying in several particulars.

The area of forests in Baden is 510,924 hectares (1,262,493 acres.)

I visited the Polytechnicum at Carlsruhe in going to the International Exhibition held in Vienna in 1877; and I have had no opportunity of revisiting it.

According to the notice of this School of Forestry given by Dr Lorey, it, together with the institution of which it is an integral part, is under the control of the Minister of the Interior. There are still only two professorships of forest science, the holders of which alternately, in different years, occupy the post of President of the School of Forestry. The prescribed course of study extends over three years, during which aspirants to the State forest service may study at a Technical School, a University, or an Academy.

The requisite to admission is an exit certificate of proficiency from a gymnasium or a *Real-schule* of the first rank. The instruction given comprises the special study of prescribed fundamental sciences, and theoretic study of special professional subjects. Proficiency in the first must be determined by the entrance or preliminary examination, which takes place once a year in the Polytechnicum before a commission composed of professional men. Proficiency in the strictly professional studies is tested by the annual principle examination, before a commission composed of some of the members of the commission for the administration of the State domains, and other State officials, and men of learning. Amongst subjects of examination are included rural economy, elementary mechanics, analytic geometry, differential and integral calculus. There is no special forest *Revier* or district appropriated for forest study. The excursion region is the nearest zone of the neighbouring extensive forests of the valley of the Rhine and the Black Forest. The number of students in the summer session of 1885 was 16, and in the winter session 1885-86 26, of whom respectively 2 and 8 were not subjects of the Grand Duchy of Baden.

## CHAPTER IX.

### REQUIREMENTS FOR ADMISSION INTO THE FOREST SERVICE OF GERMAN STATES, IN WHICH THERE DO NOT EXIST SCHOOLS OF FORESTRY.

IN States of Germany in which there do not exist Schools of Forestry, the lack is met by requiring aspirants for employment in the forest service of the State to study at one of the Schools of Forestry in regard to which information has been supplied, and otherwise to qualify themselves for official appointments. Dr Lorey, Professor of Forest Science in the University of Tübingen, reports the following as the arrangements in the several states named :—

In *Mecklenburg-Schwerin* the requirements for admission to the forest service are determined by Order of the 10th January, 1883. The service is divided into two sections—the service of *Revier*, or district foresters, and that of inspectors of State forests.

For admission to the career of a *Revier* forester there are required the qualifications necessary for entering the first class of a gymnasium, or of a *Real schule* of the first order, one years preparatory instruction, attendance throughout a full course of study in a School of Forestry, or at a University in which there are professorships of forestry, and an examination on theoretical forestry. Previous to this examination the aspirant to the service must serve one year as a volunteer in the *Mecklenburg Jäger* battalion. An examination in theoretical forestry is held twice a year by a commission under the presidency of a Minister of the Cabinet conducted by one or it may be two forest

inspectors, and two professional men for the examination in mathematics, natural sciences, &c.

For the career of a forest inspector there is required, in addition to what has been mentioned, a full *Maturitäts* certificate from a gymnasium or *Real-schule* of the first order, and attendance for at least two sessions at a University in the study of jurisprudence and political economy, and with these the qualifications of an officer of the Reserve.

In *Mecklenburg-Strelitz* for admission to the forest service there is required a *Maturität* certificate from a gymnasium or a *Real-schule* of the first order, one year's preparatory instruction, attendance at one of the Prussian Schools of Forestry, and examinations at the same according to the form prescribed for foreigners who are not Prussian subjects, and experience in land-surveying and levelling attested by a geometrician.

In *Oldenburg* the requirements for employment in the forest service of the State is determined by law of 18th April, 1864. There is required a certificate of fitness for entering the first class of a gymnasium, or the equivalent exit certificate of the Upper Burger school in Oldenburg, one year's preparatory instruction, two years' study at a superior School of Forestry, or at a University, and examination by a Commission at the Ministry of Oldenburg.

In *Brunswick* instruction in forestry was given in the Caroline College in Brunswick, for years previous to 1777, but since that time this has been discontinued. The present requirements for admission to the forest service of the State are regulated by an Order of 6th November, 1874. They are a *Maturitäts* certificate from a gymnasium, or a *Real-schule* of the first rank, with unexceptional entry in regard to mathematics, one year's preparatory instruction, attendance of at least two years at a course of study at an Academy, a Polytechnicum, or a University, upon which there follows once a year an entrance examination in Brunswick.

In *Meiningen* the requirements are determined by Order of 8th April, 1871. They consist of fitness to enter the

highest class in a gymnasium, or *Real-gymnasium*, one year's forest training, attendance at a School of Forestry, the choice of which is optional, but attendance at the full course of study in which is required, and submission to the forest examination in Meiningen, or instead of this, the production of certificate of having passed the examination of the forest institute in Eisenach.

In *Altenburg* the requirements are determined by Order of 12th November, 1864. They are fitness for entering the first class of the gymnasium, one year's forest training, at least two years' course of study at a School of Forestry, the selection of which is at the choice of the aspirant. Any who study at Tharand, and submit to the final examination required there, need no other testimonials; otherwise they must submit to an examination analogous to that, in the College of Finance. For the higher appointments in the service there are required a complete *Maturität* certificate from a gymnasium, and at least one year's study at a University.

In *Coburg-Gotha* the requirements are determined by law of 24th April, 1860. They are fitness for entering a first class in a *Real-schule*, satisfactory acquaintance with mathematics and skill in arithmetic, one year's preparatory instruction, attendance at the School of Forestry of Eisenach, or other Forest Academy, or alternately at a University, and an exit certificate from this school after passing an exit examination in accordance with arrangement between Weimar and Gotha-Coburg.

In *Anhalt* the requirements determined by Order of 20th October, 1877, are a full maturity certificate, one year's preparatory instruction, a two years' course at least of professional study, the choice of school being left with the aspirant, and attendance of at least a year and a-half at a University for the study of jurisprudence and political economy. In the case of a superior official appointment being desired, besides an examination in the theory of forestry, a *tentamen* in forest science before an examination commission of the Grand-Duchy, or alternatively at a Forest Institute.

*Schwarzburg-Sondershausen* has the requirements determined by Regulation of 24th March, 1876. They are, fitness for entering a first-class in a gymnasium or *Real-gymnasium*; one year's preparatory instruction, at the least a two years' course of study in an Academy or a University, and examination at Eisenach.

In *Schwartzburg-Rudolstadt* the requirements determined by Regulation of 16th March, 1871, are a maturity certificate from a *Real-schule* of the second rank, or that for the first-class of a gymnasium; and in other particulars such as are required in *Schwartzburg-Sondershausen*.

In *Waldeck* the requirements are determined by Order of the 12th December, 1883, supplementary to Orders of 12th February, 1856, and 12th June, 1876. They are, a maturity certificate of a gymnasium, or *Real-gymnasium*; one year's preparatory instruction, and, at the least, two years' attendance at a superior forest institute, and submission to a *tentamen*.

*Reuss-Gratz* has no particular specification, but the younger branch of Reuss requires, according to Orders of 3rd May, 1875, and 6th December, 1882, a maturity certificate from a gymnasium, or *Real-gymnasium* or *Real-schule* of the first rank, at the least six months' preparatory instruction, the study of forest science at any German School of Forestry, with, at the least, a course of five sessions, and a certificate of having passed the whole of the examinations of the same.

*Schumburg-Lippe* requires a maturity certificate, preparatory instruction, attendance at a School of Forestry, and a forestal examination.

*Lippe-Detmold* has the requirements determined by Order of 13th January, 1886, which are a maturity certificate from a Latin gymnasium, or a *Real-gymnasium*, with unexceptional statement in regard to mathematics, and a year and a-half preparatory instruction, military service, with the qualification required of a reserve officer, two years' attendance at a School of Forestry, determined by



the Forest Directory, and a general examination at the Academy in accordance with what is required in Prussia.

*Alsace-Lorraine* has the requirements determined in accordance with the law of 30th December, 1870, publication by the Chancellor of the Government of 24th March, 1874, Prescriptions for the examinations of 5th October, 1875, and Order of 13th November, 1883. They are, a maturity certificate of a gymnasium, or *Real-gymnasium*, or *Real-schule* of the first rank, with an exceptional statement in regard to mathematics, at the least seven months' preparatory instruction, two and a-half year's attendance at a Forest Academy or University, and the passing of a preliminary examination, which is held once a-year in Strasburg, by a mixed commission, under the presidency of the Landforstmeister. It is, moreover, determined that Germans who submit to the preliminary examination, and other examinations, are admissible to the practical training, and subsequently to the State examination. Moreover, Germans who do not exceed thirty-one years of age, and have spent at least two years in study at an Academy, and have passed through all the requirements for the superior grades in the forest service of their own country, may be, after a year's perfectly satisfactory employment in the forest service of Alsace-Lothringen, admissible to permanent appointment in the same.

*Dr Lorey* states that in every case in which no special mention is made of physical qualification, the full fitness for the military service is required; and that this applies also to the before-mentioned States, in which Schools of Forestry have been established.

## CONCLUSION.

THE Schools of Forestry in Germany are so connected with the general arrangements for primary, secondary, technical, and university education, as to form an integral part of the educational institutions of the country, which affects both the organic constitution of the school and the mode of study, and to some extent, the subject matter of instruction. The School of Forestry in all its phases in Germany is an institution adapted to the school system of the country; but arguments advanced in support of the proposals to transfer the provision for instruction from the special school to classes in the University, or other superior educational institution of the country, may be found applicable in other countries in which the establishment of a School of Forestry may happen to be contemplated as has been shown.

The subject was discussed in documents issued by the Government of Bavaria in connection with the question raised in regard to an *erfkenburshe* maintenance of a special School of Forestry at Aschaffenburg, and the establishment of professorships of forestry in the University of Munich.

After lengthened consideration, in which as an aid to the discovery of arrangements which might most satisfactorily meet the requirements of the service, opinions were solicited from distinguished students of forest science and forest economy known to hold different views upon the subject, which opinions were printed and fully considered, and it was ultimately determined that in all the circumstances of the case it was expedient to maintain a School of

Forestry at Aschaffenburg, from which candidates for subordinate appointments in the forest service passing satisfactorily the exit examination, might be received into the service, while students aspiring to appointments to superior offices in the service should proceed to the University of Munich, and if found qualified, prosecute there the study of forest sciences required to fit them for the efficient discharge of the duties pertaining to the offices to which they aspired.

The arguments may be considered as resolving themselves into these two : in a University or Polytechnicum there may be secured at less additional expense superior and more comprehensive professional teaching and instruction than at a special School of Forestry, while the facility with which forests at a short distance, or more remote, may be visited by the students under the guidance of a teacher, or made the field of actual work, compensates any advantage by a special school located in or adjacent to a forest and does so without distracting the attention of the students from their studies. And at a University, or similar institution, there may be secured the general culture becoming a Government official, and advantageous to the individual and to the community in many ways, while the tendency of residence and study at an isolated special school is to cramp and warp the intellectual development and social virtues.

The position in the educational system of the country which is most desirable for a School of Forestry to occupy in the country was more comprehensively discussed in a Congress of German foresters, forest administrators and professors, and students of forestry, held at Freiburg in the autumn of 1874.\* The question was submitted in this form : *Forst-Akademie oder Allgemeine Hochschule ?* Under this latter designation are comprised the Polytechnicum and the University in con-

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\* In regard to this discussion some additional information is given in a volume entitled *School of Forest Engineers in Spain*, indicative of a type for a *British National School of Forestry*, pp. 214-217.

tradistinction to which is the *Fach-schule* or training school for some one profession like the *Forest Academy*, which may be considered as differing as completely from the primary, and secondary, and superior common schools, as from the gymnasium, the *Real-schule*, the *Bürger-schule*, the *Gewerbe-schule*, and the *Allegemeine Hoch-schule* if not more so, the difference between the *Fach-schule* and these being this—the *Fach-schule* provides education, instruction, and training for some one special *fach*, trade, or profession; the Polytechnicum does so for several, it may happen to be for many such; while the University, as its designation implies, contemplates provision for the study of everything, or at least of every department of study, and preparation for all, or each of all, the so-called learned professions.

It is in view of this difference mainly that the question *Akademie oder Allegemeine-Hoch-schule?* has been discussed in Germany. This once decided in favour of the *Allegemeine Hoch-schule*; it may have been the case that there may have been in some places local discussions as to the relative advantages of the Polytechnicum and the University; but I have never heard of such, excepting in one case, which will be mentioned immediately. The question seems to have been generally determined by the accidental circumstance of which was at command. Where there was a Polytechnicum but no University the Polytechnicum supplied a home for the School of Forestry. Where there was a University and not a Polytechnicum, there was no room for question; where, as was the case in Munich, there was both a University and Polytechnicum the preference was given in accordance with the guiding principle to the University, in the absence of anything creating a reason why this should not be done.

In regard to all the Schools of Forestry in Germany, of which mention has been made, it is reported by Dr Lorey, that besides the regular demonstrations, forest exercises, and forest excursions, there are more extensive excursions for study and observation undertaken in the same over other States.

The early history of the movement, issuing in the organisation and establishment of Schools of Forestry, shows that it was desired to found forest economy upon a scientific basis; and the arrangements adopted at these stations for forestal experimental research, established at the sites of existing Schools of Forestry, justify the designation *Forst-Wissenschaft*, or Forest Science, given to the basis upon which the advanced forest economy of the day is based. It is inductive in its method; it has been so from the first organisation of the embryo forest schools of a hundred years ago; and it had been so for a long time before. The schools of Hartig and Cotta were in reality associations of enthusiastic young foresters, acting under the influence of sagacious experienced seniors, by whom they were instructed as to what observations to make while engaged in the execution of their ordinary work; to whom they communicated the results; and with whom conjointly they sought by mathematical calculations and otherwise to evolve the laws regulating the growth and increase and natural reproduction of forests, and of trees of different kinds growing under different conditions. And the importance which is attached to having a true scientific basis, for everything that is done is indicated by the expenditure bestowed upon stations for experimental research, which are established at the sites of several Schools of Forestry.

I have not at command details of the expenditure upon each and all of these. I find it reported in 1863 that the expense of maintaining the stations vary greatly. For the year ending 1882 the expenses of the stations in Prussia amounted to 27,000 marks = £1,356; Bavaria, 44,000 = £2,200; Saxony, 14,000 = £700; Wurtemberg, 7000 = £3,500.

The total amount expended annually for the maintenance of forestal experimental stations in Germany some years ago was about £6000.

The importance attached to the instruction given in

Schools of Forestry in regard to the practical application of forest science as formulated in the past, and as being extended in the present, is indicated by the requirement of attendance at foreign schools by forest officials in States in which there is no national provision for such instruction; and it is further indicated by the amount of expenditure incurred in the organisation and maintenance of such institutions where they have been established.

I have mentioned elsewhere \* 'there is some difficulty in stating what may be considered the total expense incurred in the maintenance of almost any of the Schools of Forestry on the Continent,' from this circumstance among others—in the published accounts no mention is made of what might be considered the equivalent of rent for the premises in which the school is located, and of the grounds connected with these—whether a simple arboretum, or an extensive forest, as the case may be. I know not an exception. The premises and grounds, sometimes a mansion, sometimes a palace, with corresponding appointments, is granted by the Government free of reckoning. The rent of such premises, if charged, would add greatly to the actual expenditure.

'On examination I find in the Forest Budget of Spain for 1882, and I have no reason to suppose that that was in any way an exceptional year, the credit asked and granted for the School of Forestry was 33,750 pesetas or francs; but this did not include the salaries drawn by the directors, professors, and assistant professors, as members of advanced grades in the corps of forest engineers, amounting to a much greater sum, probably about 70,000 pesetas; in all, 103,750 pesetas, say £4,600.

'In the French Forest Budget for 1880, and in that of the preceding year, 1879, there was asked and granted for instruction in forestry 208,785 francs, about £8,700, of which sum 98,800 francs were designed for the School of Forestry at Nancy.

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\* *School of Forest Engineers in Spain, indicative of a type for a British National School of Forestry.* Edinburgh: Oliver & Boyd. London: Simpkin, Marshall, & Co. 1886.

‘ There existed at that time an organisation for imparting what is called secondary instruction in forestry in other schools situated at Villers-Cotterets, Grenoble, and Toulouse, to which forest engineers under forty years of age were admitted without being subjected to an entrance examination. The course of instruction extended over seven months ; this was attended by men in active service, and any who passed satisfactorily the final or exit examination were eligible for appointment as *garde-general adjoint*. But it was found by a sub-committee of the Chamber, to which had been submitted questions relative to the instruction in forestry, that the system followed at these schools failed generally to produce men fitted for the duties which the holders of that office were, by the forest regulations, required to discharge ; and the committee recommended that these schools should be given up as not accomplishing the object for which they were organised. The instruction given in these schools represented an annual expense of 22,300 francs.

‘ The credit granted also included provision for the Ecole Forestiere at Des Barres-Loiret, founded by M. Vilmorin, and so designated by him in contradistinction on the one hand to a nursery, a designation borrowed from domestic life ; and in contradistinction on the other hand to a plantation or forest, it being a collection of trees raised from seed obtained from forests or from nurserymen or seedsmen of note, and reared with a view to the study of their habits, their identity, and their differences—an establishment such as an arboretum might be made. Subsequently to the death of the founder it became State property. Since then it has been greatly extended, and there are received into it, after passing satisfactorily an entrance examination, sons of forest overseers, for two years’ study, to prepare them for employment as gardeners or as forest warders ; instruction being given to them in French, drawing, mathematics, land surveying, sylviculture, and all details of forest service. For this instruction there was allotted 20,610 francs to cover the salaries

of a director, of a *garde-general* or warden, and of a brigadier, the wages of the students, and other expenses for materials. The grant for the whole of the schools was, as has been stated, 208,785 francs—say £9280.'



## ADDENDA

### RELATING TO THE PROJECTED ESTABLISHMENT OF A BRITISH NATIONAL SCHOOL OF FORESTRY.

#### I.—SUITABLE SITE FOR A SCHOOL OF FORESTRY.

WHILE the details given in preceding pages may possess some value as information in regard to an important movement resulting in organisations which have been extending over the length and breadth of Continental Europe, they have been compiled and translated chiefly in view of the possibility of their proving useful in the event of a British National School of Forestry being established at some future time, and in the hope of promoting measures for the accomplishment of such an object.

With regard to a site I may say: With a high sense of the appropriateness of the arrangement adopted in the initiation and early development of Schools of Forestry in Germany, and a high appreciation of what was then effected through work done in connection with forests adjacent to the schools, and appropriated to them as educational appliances, I sympathise entirely with the views now entertained extensively and almost universally in regard to the surpassing importance in the present day attaching to the provision for forestal instruction being combined, if not also incorporated, with universities or similar superior educational establishments.

In visiting Schools of Forestry, and in reading of their origin and existence, it appeared to me, most, if not all, of the old-established institutions were adjacent to forests, while most, if not all, of the later founded schools were not; and that some of these made much more use of forests somewhat remote from them for the practical train-

ing of students than did some of the former appear to me to make of like facilities for the work at their own door. It certainly was the case that practical training was not neglected by any ; and I never heard a complaint of want of facility for securing this.

The distinction I have drawn between old-established schools, and later founded schools, receives an illustration which may be cited. I have often met with convictions in favour of different forms of ecclesiastical creeds and organisations prevailing on one side, and on another of geographical boundaries ; and so have I seen it with these conflicting opinions in regard to these Schools of Forestry.

That the reader may be able to make any allowance which he may think proper for the influence of prejudice or pre-possession, I may here state clearly what I have often indicated or stated elsewhere : my opinion is decidedly in favour of the education and technical instruction being prosecuted in connection with facilities for prosecuting, without interruption, higher studies, with other months spent annually in observing, and, if possible, in practising, forestal operations under properly qualified teachers of practical forestry.

And having made this statement, I feel free to advance, and state that I have never known of a forest official in the south of Germany advocate a return to the old model in so far as it was essentially a school organised in connection with a forest ; and I have never known such a location for a School of Forestry advocated in Germany, or out of Germany, by any one known to me to be acquainted with the details of instruction in different existing Schools of Forestry, who had not himself been educated at a School of Forestry so located. I do not call in question the fact that such may have had far better opportunities of forming a satisfactory opinion on the subject from experience than I have from limited personal observation and hearsay ; and I mention the fact cited in the full knowledge that it may tell both ways.

In more than one case on visiting a School of Forestry,

I have looked in vain for a forest, or even for an arboretum, such as that in Edinburgh is becoming, and yet may become; and even where a removal of location has been made to the site now occupied by a school adjacent to a forest, it has never been from a university town to an exclusively forest district.

In Denmark, the School of Forestry is connected with the School of Agriculture and Rural Economy in Copenhagen. In Sweden, the principal School of Forestry is in Stockholm, and the practical training is effected at a distance. In Finland, the School of Forestry is at Evois, adjacent to a forest; but the practical training is conducted elsewhere. In Russia, the principal Schools of Forestry are in St Petersburg and Moscow; the practical training is at Lissino. In Saxony, the School of Forestry is at Tharand, adjacent to a forest. In Prussia, the School of Forestry is at Eberswalde, adjacent to a forest. In Hanover, it is at Munden. In Hesse-Darmstadt, the School of Forestry, after mature deliberation, was incorporated with the University of Giessen. In Baden, the School of Forestry is connected with the Polytechnicum of Carlsruhe. In Wurtemberg, it was formerly part of the Royal Academy of Rural and Forest Economy at Hohenheim, and is now combined with the University of Tubingen. In Bavaria, the School of Forestry acquired a high reputation at Aschaffenburg, but it has been in part removed to be combined with the University of Munich. In Austria, the School of Forestry has been removed from Mariabrum to Vienna. In Italy, the School of Forestry is at Vallambrosa, in the midst of a forest. In Gotha, the School of Forestry is in Eisenach, not far from a forest. In Switzerland, the School of Forestry is combined with the Polytechnicum at Zurich. In France, the School of Forestry is in Nancy, adjacent to a forest. In Spain, the School of Forestry has been removed from Villaviciosa to the Escorial, where an effort is being made to establish an arboretum, but with little prospect of success; and the maintenance of a Crown forest in a distant province, as a

special school for practical instruction, has been abandoned; and looking at the experience of Schools of Industry on the Continent, I am satisfied that there is no necessity for the organisation of a School of Forestry in Britain being clogged with the supposition that it must be located in a forest.

## II. — EDUCATIONAL ARRANGEMENTS DEEMED SUITABLE FOR A BRITISH NATIONAL SCHOOL OF FORESTRY.

I was called to give evidence before a Select Committee of the House of Commons, appointed 12th May, 1886, to consider whether by the establishment of a forest school or otherwise our woodlands could be rendered more remunerative. I was asked among other things—

Q. 202. How far do you think a forest school for the use of Great Britain should be formed upon the model of the modern Continental schools? To which I answered— I am acquainted with every School of Forestry upon the Continent, and have visited several. There are many upon the type of which a British school might be formed there is no one to which as a type the British school should be conformed, much less any one which would serve as a model. I was then asked—

Q. 203. Which of their forest schools, upon the whole, do you think would be the one most nearly adapted to our requirements?—If in Edinburgh, I should think the school in Spain.

Other questions followed, which I quote with the answers given.

204. If the school were established in Edinburgh what arrangements do you suggest should be made in regard to it?—It depends very much upon the form that it may take. If it were a private enterprise, managed by the Arboriculture Society, or the Highland Agricultural Society, one form; if it were connected with the Watt Institute, another; if connected with the University, a third; if connected with the Museum of Art and Science under the Committee of Council on Education, a fourth.

205. Which, upon the whole, do you think would be the best?—I have a very strong conviction that, upon the

whole, it is best that it should be connected with the Science and Art Department of the Committee of Council on Education, if it were founded upon some such model as the School of Mines in London, or the School of Science in Dublin.

207. Would you be prepared to give the Committee a rather more definite sketch as to how you would propose to arrange the system?—One great advantage of its being in connection with the Committee of Council on Education is this: it is desirable to have young Scotch foresters thoroughly educated. They are fitted by heredity, and by early training, for giving themselves entirely to forest work; it is, therefore, desirable that they should be specially trained. In connection with the School of Mines in London, and the School of Science in Dublin, there is ample provision made for the support of any of the students who require support, and yet it is not given as a dole, or as an alms, but as the result of competitive examination and merit.

194. Do you consider it would be necessary to have a tract of woodland closely contiguous to such a school?—Not at all.

195. But you would be of opinion, would you not, that it would be necessary to have control of a tract of woodland, although it need not necessarily be immediately on the spot or contiguous?—I may state my opinion, and that is the opinion of the majority of the forest officials, forest administrators, and professors of forest science on the Continent——

196. That the management of this particular tract of forest should be under the control of those who were charged with the instruction in the forest school; is that so?—No; not at all. The question has come up on the Continent in this form: a conference of German foresters, forest administrators, and professors of forest science was held when the question was discussed: Is it desirable to have Schools of Forestry as separate and special institutions, or to have them connected with the higher schools and

universities of the Continent? It was only incidentally that the question of forests came up in that connection. There were only three or four in favour of maintaining the old special schools in connection with the forests; the rest, to a man, were opposed to it.

197. Then you do not think it necessary that the management of the woodlands in which the instruction is given should be under the control of those who give that instruction?—Although it is not necessary that it should be under the control of those communicating the instruction, it is desirable that there should be forests to which the students along with the professor may have access. They may be in the neighbourhood of a school; if in such neighbourhood, so much the better; but they may be 100 miles off, or they may be 200 miles off. It is desirable that they should have forests to which they have access, but it is not necessary that those should be under the control or direction of those communicating the instruction.

210. Have you prepared a detailed curriculum which you would suggest. I assume a three years' course of study?—I have. My suggestions are as follows:—

FIRST YEAR.—In the Winter Session, let instruction be given in the structure and physiology of trees and shrubs, and in the geographical distribution of forests; in the treatment of forests by *Sartage*, by *Jardinage*, by *à tire et ai.e.*, by *les compartments*, or the *Fachwerke Methode* of Germany; in the application of this to coppice wood, with a view to securing, along with other advantages, a sustained production of wood; and in the application of it to timber forests, according as the object may be to secure from these a maximum size of timber, or a maximum produce of wood, or a maximum pecuniary return, along with natural reproduction, sustained production, and progressive improvement of the woods; and in measures to be employed in the conversion of coppice wood into timber forest, of timber forest into coppice wood, of mixed woods into either, and of either into mixed woods.

With attendance on the classes in the University for the study of natural history, of mathematics, and of engineering; or, with attendance on the classes in the Watt Institution and School of Arts for the study of mechanical philosophy and of mathematics.

SUMMER SESSION.—Attendance on the classes in the University for the study of botany and vegetable histology; and of practical natural history, and of practical engineering; or attendance on classes, if open, in the Watt Institution for the study of botany, and of mechanical and geometrical drawing.

AUTUMN MONTHS.—Tours of observation, with or without the teacher, in woods and forests in Britain, in France, in Germany, or in the north of Europe.

SECOND YEAR: WINTER MONTHS.—Instruction in regard to forest economy, forest legislation, and forest literature in Britain, and in France and Germany, countries in advance of all others in forest science, and in the practical application of it to the management of forests; in Russia, where arrangements are being made to introduce and to carry out extensively the improved forest management practised in Germany and in France; in Finland, where arrangements have been made to manage the forests in accordance with the requirements of forest science; in Sweden, where the latest arrangements suggested by forest science are being carried out with vigour; in British colonies, in America, and in India, where have been introduced many of the suggestions of modern forest science, and the forest economy practised on the Continent of Europe.

With attendance on the classes in the University for the study of theoretic chemistry and practical chemistry, natural philosophy, and the practical application of the same; or with attendance at the classes in the Watt Institution and School of Arts for the study of chemistry and practical chemistry, of engineering, and of geology.

SUMMER AND AUTUMN MONTHS.—Practical experience



in the management of woods, or in the management of nurseries, to be acquired under the direction of approved foresters, or approved nurserymen.

THIRD YEAR: WINTER SESSION ONLY.—Instruction in the chemistry of vegetation and of soils; in the meteorological effects of forests on moisture, on temperature, and on constituents of the atmosphere; in silviculture, as applied in Belgium, &c., to utilise waste lands; in the lands of France, to arrest and utilise drift sands; in the Alps, the Cévennes, and the Pyrenees, to prevent the disastrous effects and consequences of torrents; on the Karst, in Illyria, to restore fertility to land rendered sterile by the destruction of trees; in the United States of America, to prevent anticipated evils; in India, to secure desiderated good; in Britain, to increase amenity, covert, and shelter;—and instruction in the injurious effects of cattle, insects, and various diseases on trees.

With attendance on the classes in the University for the study of geology, of agriculture, and, if it be desired, any of the following: for the study of political economy, of conveyancing, or of bandaging and surgical appliances; or with attendance on the classes in the Watt Institution for the study of animal physiology, of German, or of French. I may add, that in connection with the above studies I would advise that a course of instruction should be given in forest botany, in forest mycology, or the study of fungi, in forest entomology, in forest ornithology, and in forest masology.

214. This elaborate course of study that you suggest, I presume, was only for those foresters who are to be employed abroad in public work?—My view is that the students should be trained as students, and, if necessary, fitted for any appointment in India and the colonies, or at home, by their being thoroughly qualified scientific students of forestry, with the full knowledge of the practical application to be made of the science.

215. What interests proprietors in Scotland more is the kind of smaller education to be given to the foresters to whom we pay, say, from £80 to £100 a-year; have you any plan to suggest which would lay down the principles for the systematic training of such men?—I consider that if such an idea as I have thrown out were followed such students could attend the Watt Institute at comparatively small expense. They might attend one year or more, and arrangements might be made for giving them instruction in the evening, so that they might support themselves by working in the nurseries in the neighbourhood of Edinburgh. If it were considered unadvisable that they should go through a two and a-half years' course, there could be no difficulty in the professor giving a short summary of forest science in its application to practical forestry in 50 lectures, or in 100 lectures; and the attendance upon such lectures, of course, would clearly meet the case of such persons as you have referred to. I have been long desirous that forestry should be introduced into our primary schools. The arrangements made at Kensington are such as would facilitate this being done at very little expense, and thus there would be raised up a body of well-instructed woodmen, forest labourers, and others.

216. Colonel Pearson told us that he thought a sufficiently practical course might be given to foresters of this stamp in three months; do you agree with that?—I do not believe it. Referring to the views that are entertained by foresters, forest administrators who are Government officials, and professors of forest science, their general impression appears to me to be that it is desirable that when students are at college they should be at college, and that when they are in the forest they should be in the forest; that they should be at the school the whole time, except on Saturday afternoon excursions to the forest, and then spend some time, say three months, six months, or whatever time may be allowed them in practical work in the forests.

217. Where would you propose that they should go for their practical work from the Watt Institute?—For practical work there are a number of forests which are conducted in an excellent way, and the foresters there, I have no doubt, would be willing, with the consent of the proprietors, to make arrangements for receiving such students for three months if there be a winter and a summer session, or six months if they have only a winter session. But, apart from that, an idea thrown out by Captain Mackenzie, who has charge of Epping Forest, was that a school should be established in connection with Epping Forest. And he suggested that the students should be engaged in practical work in Epping Forest, and that, after a year there, the students should go on to Windsor Forest for twelve months, or to some other of the Crown forests. I asked him if he would be willing to engage students from Edinburgh, paying them wages and engaging them in the same way as students from the home college, and he said, ‘Certainly.’

229. Have you formed any idea as to the probable expense of such an undertaking; how much the Government would be called upon to contribute?—I consider that the cheapest arrangement would be one connected with the Watt Institute, towards which the Government would not be called upon to contribute anything; but then there is the want of prestige, and I refer to the effect of prestige in preventing distinguished teachers getting pupils, and getting employment for the pupils, when once they have passed through the course. The cheapest arrangement, combined with prestige, would be the establishment of a professorship in the University, because then we would have a definite sum, and we could not go beyond it. It would be more expensive, I believe, having a School of Forestry organised in connection with the Committee of Council on Education; but it need not be much more expensive at first. The great expense would be, when once it has been seen, as I have no doubt it will be seen in a year or two years, that it is desirable to go on increasing the training staff.

230. But you have no doubt that a professor in the University of Edinburgh would answer the present purposes?—A great deal would depend upon the professor. You have no security that you would have a professor with the necessary encyclopædic information to succeed the first or the second professor, and there is very great danger of the professorship degenerating into a mere respectable sinecure. There is less risk of that, I consider, in connection with the Council of Education.

231. You would hardly expect, from a practical point of view, a forester who had not had any great training in this way, except practically, to attend classes in Edinburgh over a space of three years?—Hence the advantage of having what I may call an experimental or tentative course of lectures for one year and seeing what could be done, and then entering upon a larger course subsequently if this be found successful.

232. It is your opinion that they could get sufficient information in the course of one year's lectures independently of the practical experience in the forest?—They would get the scientific information with illustrations of its practical application.

233. Then you propose that they should go into the practical work of forestry at a subsequent period of their education?—Yes, and if they would attend the summer course they might keep the autumn free for this. The autumn should certainly be spent in practical work; and if there is not a summer course they should spend the whole summer in practical work. But, as has been mentioned by Colonel Pearson, on the Continent the students go great distances with the professors; they frequently go into other countries, and if they had a professor qualified to take them to any of the countries upon the Continent of Europe, and acquainted with the languages, I have no doubt that this might be satisfactorily arranged. In the last number of *Forestry* it is suggested that they should go even to Canada.

234. Your view would be that these young men should

attend classes at the College, as they attend other classes for the purpose of general education?—Yes; I consider that if in connection with the Museum of Science and Art it is only necessary to have classes in forestry, all the accessory studies can be pursued either at the University or at the Watt Institute according to the means of students. If a student be able to go to the University, and attend the University classes, he can do so; if he have not the means or the disposition to attend the University he can go to the Watt Institute and get a thorough instruction upon the accessory subjects, leaving no necessity for anything more being done but to provide for what are strictly forest professional studies.

235. But you assume that the student would have to give up both time and attention to that particular study while at the University?—That would be exceedingly desirable; but there are many young men who support themselves by teaching while at the University; and if the arrangements of the hours were such, and a forester wished to support himself by engaging in work in the nursery, he might then attend the evening classes of the Watt Institute for all the accessory subjects, mathematics, geology, road-making, and everything of that kind.

236. Then he would pursue his course of instruction during the ordinary curriculum of his University education?—Yes.

211. Hitherto I have asked you questions with regard to the advantages which might be derived from the instruction given to the students; would you suggest that in such a school, if established, there should be any opportunity for research as to the different circumstances affecting forest products?—I consider that it would be exceedingly desirable. There are now established at the seats of several of the Schools of Forestry upon the Continent stations for research; they are not connected with the school, they are supported by the Government, but placed at the seat of the school in order that the students may have the benefit of the professor there; and

in some of the schools I have referred to, as in that in Spain, where they have failed to secure such an experimental station, very great advantage has resulted from the students being encouraged by the professor to engage in research upon a smaller scale.

212. Would you propose that such a school should likewise make any experiments with regard to the suitability of particular soils, exposure, the combination or association of different trees one with another, and other similar problems?—There are no objections to their doing so. These stations for research, to which I have referred, have an international connection; when one is formed they communicate with the others, and state the particular department to which they intend to give their attention, and they leave the rest to the others, so that no two of them shall be occupying the field of research.

### III.—SCHOOL OF FOREST ENGINEERS IN SPAIN, CITED AS INDICATIVE OF A TYPE FOR A BRITISH NATIONAL SCHOOL OF FORESTRY.

In 1877 I published a *brochure*, entitled *Schools of Forestry in Europe: a Plea for the Erection of a School of Forestry in connection with the Arboretum in Edinburgh*, in which I stated that with the acquisition of that arboretum, and existing arrangements for study in the University, and in the Watt Institute, there were required only facilities for the study of what is known on the Continent as Forest Science, to enable these institutions conjointly, or either of them, with the help of the other, to take a place amongst the most completely equipped schools of forestry in Europe, and to undertake the training of foresters for the discharge of such duties as are required of them in India, in our Colonies, or at home.

In May, 1886, I gave evidence on the subject before a Committee appointed by the House of Commons to consider whether by the establishment of a Forest School or otherwise, our woodlands could be rendered more productive, and in illustration of a statement made by me in doing so, I subsequently published a volume entitled *School of Forest Engineers in Spain, indicative of a type for a British School of Forestry*. In this I have given information in regard to advantages offered by Edinburgh as an appropriate site for such an institution; information in regard to what might be done by the organisation of a School of Forestry there under the Science and Art Department of the Committee of Council on Education, or by the establishment of a Professorship of Forestry in the University, or a lectureship on that subject in the Watt Institute, or in connection with some public body, with details of the advantages offered by each of these alternative measures, inclusive of the question of expense.

The characteristic type of the Schools of Forestry in Germany is that they are adapted to fit into the other educational arrangements of the country, which are different from what have as yet been introduced into the transitional development of national education in Britain. But the arrangement of the Schools of Forest Engineers in Spain are free from all trammels which might operate prejudicially if imposed on students of forestry in this country. The similarity of the climate and conditions of soil in Spain to what exist in more than one of our colonies, and the encyclopædic character of the education, instruction, and training given under the conditions of Spain to fit the aspirants for admission into the Corps of Forest Engineers, seemed to me, when questioned on the subject by a Committee of the House of Commons, to indicate a type of the kind of school required in Britain.

I have in common, I presume, with all who know them, an unbounded admiration for students of forest science in Germany engaged in the prosecution of investigations pursued in the stations for forestal experimental research at the sites of several of the Schools of Forestry in Germany and elsewhere, and for the professors and practitioners of forest science and forest economy in that land, and I consider it no disparagement of their attainments or of their work to consider that what meets the requirements of their country would not exactly meet the requirements of ours. Again, my testimony was not of a model but of a type which may be reproduced with divergences which could be inconsistent with conformity to a model,—conformity to a type, leaving the projector free to incorporate in his scheme anything and everything compatible with ideas which he may find anywhere if it can be shown to be desirable for the accomplishment of what is designed; and I have referred to the School of Forest Engineers in Spain only as indicative of the kind of school, which, according to my views, is required to meet our case; and it is all the more so that it



admits of the incorporation of an indefinite number of suggestions which may result from the most extensive acquaintance with what is being done in Schools of Forestry anywhere.

It has been gratifying to me to find that my volume the *School of Forest Engineers in Spain* has been approved by competent authorities there; and as the volume may be considered to possess some interest as an account of that School, irrespective of the suggestion that it may supply a type for a British School of Forestry, I cite the following notices of the volume which have appeared in Spanish Reviews:—

Notice in *Revista Contemporanea*, by Senor Don Rafael Alvarez Sereix, Engineer of the First Class in Corps of Forest Engineers, Member of the Spanish Geographical and Statistical Commission, and author of the following works:—

*Determinación de la masa leñosa de un monte*, por P. Nico (trad. del Italiano).—Madrid, 1880.

*Elementos de tasación forestal*, por P. Piccoli (trad. del Italiano).—Madrid, 1880.

*Cartas de Navarra*,—Madrid, 1880.

*La desamortización forestal*.—Madrid, 1883.

*Estudios botánico—forestales* (1.<sup>a</sup> serie).—Madrid, 1884.

*Geografía botánica*—Lugo, 1884.

*Estudios botánico—forestales* (2.<sup>a</sup> serie).—Madrid, 1885.

*Cuestiones científicas*.—Madrid, 1885.

*La opinión de la prensa sobre los montes publicos*.—Madrid, 1886.

*Discursos pronunciados en la Asociación de Agricultores de España*.—Madrid, 1886.

*Adiciones y enmiendas á la ultima edición del Diccionario de la Academia Española*.—Madrid, 1886.

‘If we had not known long the distinguished author of this work; if we had not known that he is a naturalist of advanced age, of great erudition and of wondrous activity Professor for some years in Capetown, Cape of Good Hope, and in the University of Aberdeen; if we had not

read before now valuable works by him on a multitude of questions, mainly forestal, in which he gives an exposition of modern Forest Economy, describes the Forests of England, of Norway, of Finland, and of Northern Russia, treats of the celebrated French Ordinance of 1669, of the planting of the sandunes of the adjacent Republic, of the works of reboisement in that country, of the hydrology of South Africa, and of the influence of forests on humidity of climate, &c.—even if all these had been unknown to us, the publication of this work, *School of Forest Engineers in Spain*, would have been sufficient to awaken in us interest and to quicken affectionate sympathy. For how can we do other than feel an extraordinary interest in a respected man of science, who, well-nigh an octogenarian in age, undertakes a journey to Spain, establishes himself at the Escorial, examines in detail the School of Forest Engineers there—that school of which many Spaniards are oblivious, and, sad to tell, utterly unknown by not a few—going through its cabinets, examining its rich library, studies with diligence the Spanish language, and, supplied with many of the works which have been published in regard to our forests, liberally presented to him by the authors, returns to his home in Haddington, glances through them full of enthusiasm, reads and re-reads, meditates upon them for hours, and at last composes the work to which we refer?

‘In this he first gives an account of the origin of the Corps of Forest Engineers of Spain. In the second and third chapters he occupies himself with the origin and development of the School of Forestry, from its being founded in the village of Villaviciosa de Odon to the present time; details the branches of study taken each year, the extent to which this is carried, and the manner in which the instruction is given. Dr Brown devotes the fourth chapter to an examination of some of the valuable works in the library, and, with a predilection for those written by the forest engineers, he devotes attention on these. With a view to methodising this work he divides this chapter into seven sections, in which he

treats successively of those relating to mathematics, chemistry, meteorology, botany, sylviculture, &c. ; and in succeeding chapters he applies what had been seen in Spain to demonstrate the indubitable benefit which would result to the United Kingdom from the organisation of a National School of Forestry, and the abandonment of the system of sending young men who are required for the service of the Government in management of State forests to study in the School at Nancy.

‘It is now a good many years since Dr Brown, impressed with the necessity of some such reform to meet the requirements of his country, first directed his energies to demonstrate the benefits to his country which might thence result, and to endeavour to provide for its being effected. Adhering ever since unwaveringly to his conviction on this point, he has been called on to take part in several commissions created in view of this ; and besides giving evidence before a Committee of Parliament, in illustration of which evidence this volume has been published, he has supplied trustworthy information on this question in other works which he has published ; and now in that country, parsimonious hitherto in what it has done, the idea seems to be making way ; and already not a few consider that at least a trial to give effect to it should be made.

‘We trust that ere very long this will be done, bringing much good to that powerful nation ; and that Dr Brown may live to hail the day as one of the most happy in his long and useful life.

‘We who feel ourselves honoured by his devoting a volume to the study of our School of Forestry, pray fervently that that day may come ; and meanwhile we send to him in his quiet home, in which he is engaged in the preparation of other works, an expression of our gratitude, and an assurance of our admiration.

(Signed) R. ALVAREZ SEREIX.’

Notice in *Revista de Montes*, by Illustrisimo Senor Don Castel y Clemente, Chief of Second Class in the Corps of Forest Engineers, Deputy to the Cortes, Superior Deputy Chief of the Civil Administration, Chevalier of Isabel, the Catholic, &c., and author of the following works :—

*Monografía dasográfica del haya*.—Madrid, 1873.

*Memoria sobre la influencia de la luna en la vegetación*.—Madrid, 1875.

*Noticia sobre la fundación y desarrollo de la Escuela especial de Ingenieros de Montes*.—Madrid, 1877.

*Estudios sobre el tanino*. (Memoria premiada por la Real Academia de Ciencias).—Madrid, 1879.

*Descripción física, geognóstica, agrícola y forestal de la provincia de Guadalupe*. (Publicada por la Comisión del Mapa geológico de España).—Madrid, 1882.

*Memoria sobre las condiciones naturales y producción agrícola y forestal de la Península Escandinava*.—Madrid, 1883.

*Combustibles vegetales: Teoría y práctica de la combustión, carbonización y destilación de la madera*.—Madrid, 1885.

‘The surprise which undoubtedly will be felt by the greater part of the readers of the *Revista* on the announcement of this work I experienced, and candidly acknowledge that such was the case, on my receipt of the neatly-bound volume, with a most kind dedication, for which I am truly grateful to the distinguished and learned author of it, who has during some years past devoted his great activity to the study and diffusion of Forest Science, and to the advocacy of the establishment of a School of Forestry in Britain. The name of Dr John Croumie Brown is familiar to all students of that science following the literary movements in connection with it during these late years.

‘The *Revista de Montes* — Forest Review — has repeatedly taken occasion to bring under consideration the more important works amongst the publication of this distinguished naturalist; and on more than one occasion, while expressing admiration of the prodigious fecundity, and remarkable persisting perseverance of the author, intimated the satisfaction that a writer of such

authority, and one who has such an acquaintance with the organisation of the other Schools of Forestry in Europe, should give his attention, and concede special importance to that of Spain as one indicative of a type deemed suitable to be followed in the organisation of some future School of Forestry in Britain, the creation of which was being advocated by him. To add that Dr Brown, in his last published volume, speaks of things in Spain as one well acquainted with them, detailing facts and citing data which have not previously been published in Spain, will not appear to be an extravagant statement to those who know on the one hand the searching diligence of the forestal chronicler from the other side of the British Channel, and on the other hand the indifference with which is regarded amongst ourselves what relates to the prestige of that which we, having such important interests involved, should take special care to secure that it receives due appreciation in the country.

‘The first chapter of the book to which we refer treats of the origin and development of the Corps of Forest Engineers, and of the special school of the Department in our country. He is a faithful chronicler of facts, coinciding in his judgment with the author of the *Notitia sobre el origen y desarrollo de la Escuela de Ingenieros de Montes en Espanna*—Notices of the origin and development of the special School of Forest Engineers in Spain. The first part serves as a requisite introduction to the other parts of the volume; and it also serves to show that the necessary reforms have not been impositions practised on the villages, but that in these, and in their evolution or successive developments, they have given a permanent influence to the special character and inherent conditions of the primary impulse at the time of the creation. He describes, in continuation of the School of the Escorial, the studies pursued there by the students, giving in an abbreviated *resumé* the programmes of study in the different branches, and the subjects which constitute the course of instruction required to be given to the

engineers. Taking occasion of the examination of this, and in methodic order based on the different departments of science taught to them, the author gives an analysis, with considerable detail in most cases, of all and each of the works written by the Spanish Forest Engineers, and of some which are not so, in reference to the subject matters of this instruction, constituting with regard to this the most complete bibliography which has been prepared and published on this important department of the scientific activity of the forest officials of our country.

‘I shall not say a word in commendation of the elevated standard and the careful solicitude with which Dr Brown has prepared this chapter of his work, as the correspondence of our views gives me a personal interest in the matter.

‘In the chapter headed Excursions, the respected Ex-Professor from the Cape gives an account of all of the more important excursions made from the founding of the school till now by the professors or students for the study of forest practice; and also those which have been made by professors and forest engineers into foreign lands, either in connection with commissions to visit the International Exhibitions held in London, Vienna, and Philadelphia, or to study particular points connected with instruction, the *reboisement* of dunes, forest industries, &c.

‘Dr Brown, who under the snow of age, gallantly sustained by a vigorous constitution, knows what it is to carry a heart always open to recollections and enthusiasm, not depressed by disappointment, but elevated by hope, has made his own the hymn of the first foresters of Spain, transcribing first in Spanish and then in English that hymn with its opening strophe *Al campo marchemos!* Nor less thrilling than the concluding strophe was the effect produced on me by reading in English that anti-strophe or chorus so often sung in our excursions in 1867 to the forests of the Guadarama—

“Cotta the learned! thy children in Spain  
Invoke thy name which is now immortal.”

‘The remaining chapters are devoted to making manifest the conveniences which exist for establishing forestal instruction in Britain, discussing all the questions which present themselves at once relative to the choice of a site for the establishment of a school, the extent and form of instruction required, the expense which provision for this would entail, &c.

‘It is nothing new for us to hear well-merited commendations bestowed upon the establishment and organisation of the School of Forestry in Spain. We know the opinions of illustrious foresters in Germany, published some years ago, in accredited reviews of that country, according to which our former school in Villaviciosa, for its programme of study, its regulations, the riches of its museums, and the special stamp which has always characterised it, was presented as a model in that classic land of forest science, which delights to see order, method, and discipline, as the distinctive characters of all its institutions; but it is none the less satisfactory that that judgment should be maintained in the present: and after all, throwing aside all idea of presumption, which would be ridiculous, it is always pleasing and strengthening to conviction to see that there is something deemed deserving of imitation in a country looked upon with such indifference, and that perhaps not altogether unjustified, by its own not unjustifiable neglect.

‘The continuous advocacy by Dr Brown during these latter years has been followed with the effect that the opinion is spreading in his country with manifest indications of conviction that the views which he urges in this matter are of grave import to Great Britain, not only in relation to its home territory, but more and more particularly in order to the increase of commerce and production in the vast territories of her colonies. In this matter, if I be not greatly mistaken, it is my belief that at no distant time there will be established a School of Forestry in Edinburgh; and meanwhile, without waiting for that, I invite all my associates, who see in Dr Brown

an enthusiast in our science, and a loving friend of the Forest Engineers of Spain, to unite in fraternal salutations to him; and in conclusion, in the behalf of these foresters, we send to him, with sincere gratitude, these pages of this *Revista*.

‘ Madrid, 25th October, 1886.

‘ (Signed) CARLOS CASTEL.’



#### IV.—TREATISES ON MATTERS PERTAINING TO MODERN FOREST SCIENCE AND FOREST ECONOMY, PREFERRED FOR PUBLICATION IN THE ENGLISH LANGUAGE.

Pending the creation of a public opinion in favour of the establishment of a British National School of Forestry, useful information in regard to Forest Economy, based on the advanced forest science of the day may be disseminated through the press ; and thereafter the publications embodying this may prove helpful to students desirous of extending their studies beyond the instruction communicated in the classes attended by them.

In the volume entitled *School of Forest Engineers in Spain, indicative of a type for a British National School of Forestry*, I had occasion to state ; ‘ We have an extensive and valuable literature relative to Arboriculture. For this there is, and ever has been, a demand : but with works on Sylviculture, Modern Forest Science, and Modern Forest Economy, it is otherwise. Nor is there yet such a demand for works of this kind as would make it pecuniarily remunerative to any to engage largely in the publication of such works ; but as the demand increases so will the supply.

‘ But a beginning has been made. In so far as I have taken part in this I have done so in anticipation of a future demand, and not in consequence of any manifestation of a felt want. In reference to the rapid supply of works on forestry in the Spanish language of late years, which I have noted, I may remark that this did not occur until after several successive batches of students had entered upon the active duties of their profession. It was then that it became manifest wherein the existing forestal

literature of the country was deficient in view of the requirements of the day; and then that the desire for information induced purchase and perusal. And it is noteworthy that even still in connection with the publication of almost all of the Spanish works referred to, including the most expensive and least popular of them, the writers are relieved of the expense of publication. It is not so with us.'

In connection with this statement there are given notices of the contents of several treatises which I have published. I am prepared to proceed with the publication of others; but I am straitened by lack of funds. Silver and gold have I not; but what I have I am prepared to give.

My attention was first given to the Forestry and Hydraulic Engineering of Spain, in consequence of the similarity of the climatic conditions of the Peninsula to those of South Africa, which I had studied with some attention, and of a perception that the remedial measures adopted in Spain were adapted to meet and counteract corresponding evils in South Africa. With both I have long been familiar, but I had occasion to visit Spain in the summer and autumn of 1885, when I had many facilities afforded me of verifying and extending information I had previously procured; and in the end of the year I sent a letter in triplicate to editors of newspapers, published at the Cape of Good Hope, of which the following is a copy:

'Haddington, 16th Decr., 1885.

'Sir,—May I ask of you in the interests of the Colony to give publicity to the following statement?

'During the years 1863-1866 I held at the Cape of Good Hope, along with the Professorship of Botany in the South African College, the office of Colonial Botanist,—an office established in 1858, created with the twofold object—1st, of ascertaining and making generally known the economic resources of the Colony as regards its indigenous vegetable productions, and its fitness for the

growth of valuable exotic trees and other plants; and 2nd, of perfecting a knowledge of the flora of South Africa, and thus contributing to the advance of botanical science.

‘Appended to my report as Colonial Botanist for the year 1886 was a list of upwards of 460 names of South African trees, shrubs, and arborescent herbs, upon the natural history, or botanic characters, or economic uses of which a report was forthcoming, if desired; the list consisting of English, Dutch, Kaffir, Sechuana, Damara, or Hottentot names, by which these are known at the Cape, alphabetically arranged with their botanic synonyms. 2. An abstract of a memoir prepared relative to the forests and forest lands of South Africa. 3. An abstract of a memoir prepared relative to the forest economy of the Colony. 4. An abstract of a memoir prepared relative to arboriculture in the Colony. 5. An abstract of a memoir prepared on the hydrology of South Africa. 6. An abstract of a memoir prepared on irrigation and its application to agricultural operations in South Africa. And, 7. Observations on the agricultural capabilities of the Colony, and requirements for the developments of these.

‘Since my return to Europe I have repeatedly, in correspondence with South Africa, made mention of the similarity of the climate and physical conditions of Spain to those of the Colony, and of the appropriateness for adoption in South Africa, of the measures adopted in Spain to secure the conservation and scientific exploitation of forests, and the retention and economic application of the water furnished by the rainfall, as conjointly means of arresting the desiccation, and counteracting the aridity of the country.

‘Similar measures I advocated unceasingly during my tenure of office at the Cape, and in a volume which I published in 1875, entitled: ‘Hydrology of South Africa, or Details of the Former Hydrographic Conditions of the Cape of Good Hope, and of Causes of its Present Aridity, with Suggestions of Appropriate Remedies for this Aridity,’ I

endeavoured to show that the appropriate remedies are the erection of dams to prevent the escape of a portion of the rainfall to the sea ; the abandonment or restriction of the burning of the Veldt ; the conservation and extension of existing forests ; and the adoption of measures similar to the reboisement and gazonnement carried out in France, with a view to prevent the formation of torrents, and the destruction of property occasioned by them.

‘ This year I spent two months in Spain in frequent intercourse with distinguished members of the Corps of Forest Engineers, with some of whom I have had correspondence on such matters for years ; and by them I was afforded every facility I could desire for verifying and increasing the information I had previously collected. I have now completed the arranging of the information I thus procured, and incorporating with it the information I had previously obtained ; and the whole I have embodied in a series of treatises or reports on the following subjects, viz. : 1. Forestry in Spain ; 2. Forestal and Hydraulic Engineering ; 3. Forestal and Rural Industries, including, amongst others, the production of cork—the collecting of resin from conifers—the collecting of esparto grass—the treatment of merino sheep—the culture of the olive—the preparation of silk—and the making of wine. 4. The natural history of the phylloxera, and appliances adopted to prevent its ravages. 5. The natural history of the locust, and measures applicable to its destruction.

‘ It is not my intention to publish these on my own account, or otherwise, than as a contribution towards the development of the agricultural capabilities and rural economy of South Africa, in furtherance of the design of the office of Colonial Botanist which I held at the Cape ; and I am prepared to carry through the press, free of all expense, beyond the charge of the printer for paper and work, an edition of 100 copies, or of such other number as may be desired, if provision be made for meeting that expense, leaving me free, if I think proper, to have at my own expense other copies thrown off before the types may

be distributed: these extra copies to be at my disposal for distribution by sale or otherwise.

'I take the liberty to offer through you to do this, and to add I shall feel gratified if that offer be accepted.—I am, Sir, respectfully yours, JOHN C. BROWN.'

The offer has lapsed, but I now renew it, and extend the offer to all who may be willing to co-operate with me in the enterprise.

In the communication made in triplicate to newspapers published at the Cape of Good Hope there are mentioned several memoirs or reports which I prepared while holding the office of Colonial Botanist and Government Botanist in that Colony. One of these related to rivers of South Africa, with notices of inundations by which they are characterised, and of irrigation works by which they might be utilised, and of difficulties, physical and other, in the way of works of extensive irrigation being carried out at the Cape, and the means of accomplishing these which are at command. To this I have since added similar notices of the most important rivers of Africa—the Zambesi, the Congo, and the Nile. In regard to that memoir I addressed, under date of 15th September, 1881, a memorial to the Legislative Assembly, stating that, in view of what had been accomplished in Spain, I considered that it would be pecuniarily advantageous to the Colony that the Commissioner of Crown Lands and Public Works, the Members of the Legislature, and others, should have access to the information embodied in it, and offering to carry through the press an edition of it, free of all expense to the Colony, beyond what might be charged by the printer for his work, and for paper and binding.

Others related to forest management at the Cape of Good Hope in times past, latterly, and at present; to the forests and forest lands of South Africa, from the Cape of Good Hope to the Zambesi—to which I have since added similar information in regard to the forests of Central Africa

between the Zambesi and the Sahara ; and with regard to these the Report on South African trees, arborescent shrubs, and bushes ; and the memoir on arboriculture in South Africa, with details of what has been done, and of what may be done, in planting trees at the Cape of Good Hope, with a view thereby to securing ornamentation, moisture, shelter, fuel, or timber. I addressed to the Legislative Assembly, under date of 13th September, 1881, a memorial stating that abstracts of these were appended to the Report of the Colonial Botanist for 1866, which was submitted to Parliament while it was engaged in carrying out sweeping measures of retrenchment ; that in the light of the information I had obtained in regard to the advanced forest economy of Continental Europe, and in view of the reported appointment of a Forest Commission in the Colony, I considered it would be pecuniarily advantageous to the Colony that the said Commission, and also the Commissioner of Crown Lands, the Members of the Legislature, and others, should have access to these Memoirs, and offering to carry through the press copies of the original reports, which were still in my possession, and to do so free of all expense to the Colony, beyond what might be charged by the printer for his work, and for paper and binding what copies might be required.

In illustration of the importance of the matters to which these refer, I may mention that Count de Vasselot, now Superintendent of woods and forests in the Colony, reported in 1882 of these, which twenty years before were being recklessly destroyed, and were bringing in to the treasury a clear revenue of but a few hundreds of pounds. 'The first step in enlisting professional knowledge has been taken, allowing us to begin systematic forestry ; minor considerations should not be allowed to turn us aside, or impede progress in the path on which we have entered. I may, in conclusion, once more repeat my opinion that the Crown Forests, regularly worked,

would produce a revenue of at least £235,000—this being the sum which leaves the country every year to pay for imported wood. Its forests ought to be a mine of gold to the Colony; while the plantations, and re-forestation of mountains will, in conjunction with hydraulic works, turn to the best account the rainfall of the country. Irrigation would then be easier, and agriculture a veritable mine of diamonds.'

In illustration of the importance of what is thus alluded to, and of the subjects treated of in the memoir *On the Rivers of Africa*, I may cite the following statement from the Preface to a volume entitled: *Reboisement in France, or Records of the Replanting of the Alps, the Cevennes, and the Pyrenees, with Trees, Herbage, and Bush, with a view to arresting and preventing the destructive consequences and effects of Torrents*, published in 1876—'I have before me details of destructive effects of torrents which have occurred since I left the Colony in the beginning of 1867. Towards the close of that year there occurred one, the damage occasioned by which to roads and to house property at Port Elizabeth alone was estimated at from £25,000 to £30,000. Within a year thereafter a similar destructive torrent occurred at Natal, in regard to which it was stated that the damage done to public works alone was estimated at £50,000, and the loss to private persons was estimated variously from £50,000 to £100,000. In the following year, 1869, a torrent in the Western Province occasioned the fall of a railway bridge, which issued in loss of life and loss of property, and personal injuries, for one case alone of which the railway proprietors were prosecuted for damages amounting to £5000. In Beaufort West a deluge of rain washed down the dam, and the next year the town was flooded by the waters of the Gamka; and the next year, 1871, Victoria West was visited with a similar disaster. Such are the sums and the damages with which we have to deal in connection with this question, as it affects the case; and

these are only the most remarkable torrents of the several years referred to.

‘Towards the close of last year, 1874, still more disastrous effects were produced by torrential floods. According to the report given by one of the Colonial newspapers, the damages done could not be estimated at much less than £300,000. According to the report given by another, the damage done to public works alone was estimated at £350,000.’

There are other countries, besides South Africa, in which the information embodied in these treatises might be useful; and I am prepared to carry through the press an edition of any one or more of them on the same terms as those stated in the offer made to the Cape Parliament: That is to say, free of all charges beyond those of the printer for paper and work, provided I be allowed, before the types be distributed, to have extra impressions thrown off, at my own expense, for distribution by me, by sale or otherwise as I may deem expedient.

Some years since, in correspondence with the late Dr Franklin B. Hough, when he was at the head of the Forestry Division of the Department of Agriculture, in the Government of the United States in America, I had occasion to state what aid I could give in the accomplishment of an enterprise in which he was engaged heart and soul, calmly and coolly, but with all the self-denying energy manifested by not a few of his compatriots in endeavours to serve their generation according to the will of God. In connection with this correspondence, I prepared a letter to be addressed to five or six of my correspondents in America, who were like-minded, more than one of whom pre-deceased Dr. Hough, and more than one have followed him to the great gathering—the General Assembly of the First-born in Heaven. It was found preferable to writing out copies to have the letter printed; and this being done



extra impressions were ordered, and these were somewhat extensively distributed. Of this letter the following is a copy :—

‘ Haddington (Scotland), 10th December, 1879.

‘ MY DEAR SIR,

‘ In view of the interest you have manifested in the advancement of Forest Science and Forest Economy, I take the liberty to solicit your kind aid in the matter referred to in the following lines.

‘ I expect to be able in the course of this winter to bring toward completion a compilation, and, when necessary, translation, of official and other notices of Forestry in the different countries of Europe, a work on which I have been engaged for several years past. I have made such arrangements that these compilations shall, I hope, in no case prove to have been made altogether in vain ; but, by the death within these last few months, of more than one of my near relatives of the same age, by the death, within a period somewhat longer, of more than one of my correspondents in this work, and by a consciousness of my strength being less than it has been, I am reminded that I must not lose time in publishing these compilations if I would have them carried through the press before I die. For reasons, which I shall state immediately, I wish that they could be published in the United States of America ; and I wish much that you would bring the matter under the consideration of some enterprising publisher in America, with such remarks on the subject as you may think fit to offer.

‘ My attention to the official documents, and other works from which these compilations and translations have been made, was given mainly in consequence of having seen, during a professional engagement at the Cape of Good Hope, the reckless way in which valuable forests were being exploited and destroyed, and my inability, after my return to Europe, to specify any work in the English language in which those who were interested in the conservation, the more economic exploitation, and the extension of these forests, might find detailed information in regard to the treatment of forests in accordance with the advanced forest science of the day ; and having the leisure of old age, I sought to supply the desideratum as I best

could. I possessed, perhaps, exceptional opportunities for doing so; of these I availed myself; others presented themselves; they were not allowed to slip past unimproved; and throughout these years I have had correspondence and personal intercourse in their own lands, with many who were engaged in the study, the direction, the administration, or the management of forest operations on the Continent of Europe and elsewhere.

‘My desire to have my compilations published in the United States may be in part the result of a life-long intercourse with American friends, whom I have highly esteemed, and of sympathy with the spirit and the principles of American institutions; but it comes more immediately from my knowledge that much is being done to secure the conservation, economic exploitation, and extension of forests in several of the States. It is my persuasion that the information I have to communicate will be more valued, and this by a much greater number of individuals in America, than it will be by the populations of any of our British Dependencies; while in Britain, from the large local supply of coal, and the existing facilities for importing timber of all kinds which may be required, Arboriculture is virtually the one department of forest economy to which attention is chiefly given, while much more is required in the economic treatment of natural forests.

‘By the Hon. George P. Marsh, Minister of the United States at the Court of Rome; by General the Hon. C. C. Andrews, who was for many years Minister of the United States at the Court of Stockholm; by Dr John A. Warder, who was the Member of the Scientific Commission of the United States, appointed to observe and report on forest products at the International Exhibition in Vienna, in 1873; by the Hon. Dr B. G. Northrop, Secretary of the Connecticut Board of Education, who was commissioned to visit Schools of Forestry and other technical schools in Europe in 1877; by Dr Franklin B. Hough, writer of the Report upon Forestry, prepared under the direction of the Commissioner of Agriculture, in pursuance of an Act of Congress, published in 1878, and it may be others,\* much information in regard to the Forestry of Europe

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\* I may not in silence pass such official documents as that entitled *American Forests; their destruction and preservation*, by the Rev. Frederick Starr, St. Louis, Missouri, included in the Report of the Commissioner of Agriculture for the year 1865, of which a hundred and sixty-five thousand copies were printed by order of Congress—or the

has been published in America; and from the extensive judiciously devised correspondence which Dr Hough, has had, and still has, with the administrators, and managers of state forests on the Continent of Europe, and other countries, there must be in his hands an immense collection of valuable information on all subjects connected with forest economy, over and above what is embodied in the report referred to. But the subject is so comprehensive, and the mine in all its ramifications is so rich, that it is scarcely possible that two independent workers can fail to bring to light important facts and observations to which attention has been given by one, while they may never have happened to come under the cognizance of the other.

‘In illustration of the wealth of the mine, I may cite the following statement which I made some years ago in a pamphlet which I published under the title of *The Schools of Forestry in Europe*.

“‘I have had sent to me lately *Ofversight af Svenska Skogslitteraturen, Bibliografiska Studieren af Axel Cnattingius*, a list of books and papers on Forest Science, published in Sweden; I have also had sent to me a work by Don Jose Jordana y Morera, Igenero de Montes, under the title of *Apuntes Bibliographico Forestales, a Catalogue raissoné* of 1126 printed books, MSS., &c., in Spanish, on subjects connected with Forest Science.

“‘I am at present preparing for the press a report on measures adopted in France, Germany, Hungary, and elsewhere, to arrest and utilise drift-sand by planting them with grasses and trees; and in *Der Europäische Flug-sand und Seine Kultur, von Josef Wessely, General Domänen-Inspektor, und Forst-Academie-Direktor*, published in Vienna in 1873, I find a list of upwards of 100 books and papers on that one department of the subject, of which 30, in Hungarian, Latin, and German, were published in Hungary alone.

“‘According to the statement of one gentleman, to whom application was made by a representative of the Government

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Report on the Statistics of Forestry, embodied in the Report of the Minister of Agriculture, for the year 1865—with many other documents, both official and unofficial, which have been sent to me from many of the States in the Union, and from the British Dominion in North America. But these all relate to Forestry in America; those I have cited refer extensively, and some of them exclusively, to Forestry in Europe; and with such alone I have to do at present.

at the Cape for information in regard to what suitable works on Forest Economy could be procured from Germany, "the works on *Forst-Wissenschaft*, Forest Science, and *Forst-Wirtschaft*, Forest Economy, in the German language, may be reckoned by cartloads." From what I know of the abundance of works in German on subjects connected with Forestry, I am not surprised that such a report should have been given. And with the works in German may be reckoned numerous works in French.

"In Hermann Schmidt's *Fach Katalogue*, published in Prague last year (1876), there are given the titles, &c., of German works in *Forst-und Jagd-Literatur*, published from 1870 to 1875 inclusive, to the 31st of October of the latter year, amounting in all to 650, exclusive of others given in an appendix, containing a selection of the works published prior to 1870. They are classified thus:—General Forest Economy, 93; Forest Botany, 60; Forest History and Statistics, 50; Forest Legislation and Game Laws, 56; Forest Mathematics, 25; Forest Tables and Measurements, &c., 148; Forest Technology, 6; Forest Zoology, 19; Peat and Bog Treatment, 14; Forest Calendars, 6; Forest and Game Periodicals, 27; Forest Union and Year Books, 13; Game, 91; Forest and Game in Bohemian, 44. In all 652: upwards of a hundred new works published annually. Amongst the works mentioned is a volume entitled *Die Literatur der letzten sieben Jahre (1862-1872) aus dem Gesamtgebiete der Land und Forst-wirtschaft mit Einschluss der landw. Gewerbe u. der Jagd, in deutscher, französischer u. englischer Sprache. Herausg. v. d. Buchhandl. v. Gerold & Co., in Wien, 1873*, which is a valuable catalogue, filling 278 pages in large octavo.

"Were I to give a like statement in regard to similar lists now before me, it would be much more extensive."

'I enclose a list of compilations, with any one or more of which I am prepared to go to press at once; and to this is subjoined a list of volumes and pamphlets which have already appeared. Applying to the latter a designation suggested by the title of one of the works of Professor Max Müller, I would describe them as chips from the trunk, and boughs and twigs from the tree. From any of these, if known to you, you may gather the character of the others; and should any of these seem to you to promise to supply a desideratum in American

literature, I ask of you to bring the matter under the consideration of any publisher who may be likely to further the enterprise.

‘I am at present free from all engagements, and am prepared to contract at once for the publication of any one or more of the compilations in question, altogether irrespective of the order in which they appear on the list. I am open to any proposals in regard to terms; but I should like to have a specified number of copies placed at my disposal for presentation to personal friends, to writers cited, and to others who may have aided me in the enterprise, or whose co-operation I may have occasion to solicit, and to public libraries at the Cape of Good Hope, in the interest of which Colony the work was begun and prosecuted; and besides this, I should like to have (1) a royalty on all copies printed, or (2) a percentage on all sales, or (3) a share in any profits which may be realised.

‘Should it be thought expedient to print the whole, or a selection of them, as a series of uniform size, for transmission by post, this may be secured by sub-division, or by excision, to any extent necessary; and if it should be desired that the printing should be executed in America, I can get “copy” printed in slips, and corrected in Scotland, at a charge of about 4s 2d per thousand words.

‘Soliciting your good services, I am, My Dear Sir, &c.’

#### APPENDED LIST OF PROJECTED PUBLICATIONS.

##### I.—*Forest Management and Arboriculture in Great Britain and Ireland.*

In this it is shown in regard to England, that from the earliest times Forest Laws were exclusively Game Laws, and how, in later times, forest economy was subordinated to the chase. Ancient terms and usages are explained; progressive legislation is traced; detailed information is supplied in regard to the several Crown Forests, and in regard to woods and plantations, and the management of these.

With regard to Scotland, there are given abstracts and copies of old forest laws; details in regard to modern extensive plantations; with notices of the forest literature of the country.

With regard to Ireland, there are given notices of extensive forests, and abstracts of the old forest laws of the land.

## II.—*The Forestry of France.*

In successive chapters are given—The early history of forest treatment and forest legislation in France—the Forest Ordinance of 1669—the mediæval history of forest economy and legislation in France, including *Defraichment*, *Jardinage*, *Sartage*, and forest litigation of the period; notices of the continued destruction of forests, and of the remedies devised for the evil; the *Code Forestiër*; the *Ordonnance Reglementaire*—The recent history of forest economy and legislation in France, including notices of the forest administration; of servitudes, or rights of usage; of Communal woods; of concessions and appropriations given to public works; of thefts of forest products of forest fires; of the exploitation of forests; of the planting of *landes* and dunes; and of the *réboisement* of the mountains; the forests of France; notices of the literature of forest science and forest economy in France, embracing works on vegetation, vegetable anatomy, and vegetable physiology—on subjects connected with forest science—on forest economy, and works on legislation, relative to the treatment of forests; and the School of Forestry at Nancy.

## III.—*Development of Modern Forest Science and Instruction communicated in Schools of Forestry in Germany.*

After notices of mediæval forestry in Germany, and of earlier endeavours to improve it, details are given of the development by Hartig and by Cotta of the *Fachwerks-Methode*, known in France as *La Méthode des compartiments*, and of the organisation and development of Forest Schools in different German States, and of Stations for Experimental Researches. And there follow notices of the forest lands and the literature on forestry in Germany.

## IV.—*Introduction to the Study of Modern Forest Science and the Forest Economy of Continental Europe, as followed in France.*

In successive chapters information is supplied in regard to forest clearings, effected by *Sartage* and otherwise; the accidental destruction of forests by fire; the reckless destruction of forests for their products; and the prevention of their

reproduction by usages incompatible therewith. There is described the exploitation of forests by *Jardinage*, by *La Méthode à tire et aire*, and by *La Méthode des compartiments*. Information follows in regard to planting, with a view to obtaining a supply of timber or firewood; with a view to arresting and utilising sand drifts; with a view to the prevention of the formation of destructive torrents; with a view to securing humidity of soil and climate; and with a view to producing amenity and shelter.

#### V.—*Sylviculture in France.*

In this is given a *resumé* of the course of instruction in the plantation and culture of woods, followed in the School of Forestry in Nancy, comprising the artificial creation of woods, with information in regard to doing this with seeds, with seedling plants, and with cuttings and layers; the sylviculture to be practised in forests, and the exploitation of timber forests, and of coppice woods; the measures to be adopted in various forms of the conversion of coppice woods into timber forests, and of timber forests into coppice woods; and information in regard to the natural history, seed sowing, subsequent treatment, and exploitation of the more generally cultivated forest trees of Europe.

#### VI.—*Forest Management in France.*

In this is given a *resumé* of the course of instruction in the management of forests followed in the School of Forestry in Nancy, comprising requirements common to all systems of forest management followed in France; the arrangement of sections of forest for successive exploitation; the ages of the trees at which they are felled; the application to trees of the method of exploitation to be followed in the case of timber forests, of these in an irregular condition, of coppice woods, and of timber forests with an undergrowth of coppice, the object aimed at being, by every operation, to subserve conjointly the amelioration of the forest, its sustained productiveness, and its natural reproduction by self-sown seed.

#### VII.—*Sylviculture on Sand Wastes and Sand Plains of Belgium, Holland, and Northern Germany.*

Information is supplied in regard to tree planting with

success on the waste lands of Belgium ; in regard to the herbage by which sand dunes have been bound down in Holland, to sand drifts in Prussia, which have been arrested by planting them with trees ; and in regard to the management of forests on the sand plains of Northern Germany.

#### VIII.—*Sand Drifts.*

In this attention is given to the natural history of sand, what it is, whence and how the constituents of sand have been obtained and brought into the existing condition and places in which we find them ; to the phenomena presented by sand wastes on the shores of the German Ocean, and of the Baltic, and by inland dunes ; to the effects produced by herbage naturally spreading over them, and by trees self-sown or planted upon them ; and to legislation and literature relative to the arrest and utilisation of drifting sand.

#### IX.—*Danish Peat Bogs and Forests.*

Attention is given to the order in which different kinds of trees have, in a succession which may be naturally accounted for, constituted the forests of Jutland, which, so late as the eleventh century, was characterised as a *silva horrida* ; to the natural history of the peat bogs, in which remains of trees have been preserved from pre-historic times ; to indications of the habits of the early inhabitants, supplied by implements and ornaments there preserved from the so-called stone period, bronze period, and early iron period of these pre-historic times ; to the present condition of the forests or woods of Denmark ; the modern exploitation of these forests or woods, and their products ; and the forest literature of the country.

#### X.—*Forestry in Norway : with Notices of the Country and its People.*

In successive chapters are given details of forest operations, of the consumption and exportation of wood, of forest scenery, of the distribution of forests, and of different kinds of forest trees ; of forest botany ; of the tenure of land and forest rights ; of agriculture, trade, commerce, and shipping ; of the game and game laws of Norway ; and of the forest literature of the country. These are followed by like details in regard to the



physical geography of the country ; the early history, mediæval developments, and modern civil and political organisations of its inhabitants ; the number, distribution, and occupations of these ; and the finances of the country.

XI.—*Sweden : its Forests, Forest Management, the Country, and its People.*

In this are traced the successive measures by which the management of forests has in recent times been brought from what may be described as reckless waste into conformity with the most approved forest economy of the day. Details are given in regard to the forests, their geographical distribution, the home consumption and exportation of their products, the game and game laws, and the agriculture of the country ; with information in regard to the general aspect, geology, hydrography, and meteorology of the country ; and like information in regard to the history, political constitution, finances, trade, and commerce, and education of the nation.

XII.—*The Finns and Forests of Finland.*

There are described the general appearance of the country and its inhabitants, of its mountains, and of its lakes, which have procured for it the poetic designations of The land of a thousand lakes, and The last born daughter of the sea ; its flora, and its forests ; its primitive forest treatment, that of *Rhoedens* or *Sartage* ; and the successful introduction of the most advanced forest management of Central Europe ; its primitive and modern agriculture, its mines, and its minerals ; its exports, and its timber trade. And there are added ethnographical notices of the Finns, and the Lapps, and the Letts ; notices of the state of education in Finland ; and of the legends and literature of the people.

XIII.—*Forests, Forest Lands, and Forest Work in Russia.*

Details are given in regard to forests, forest lands, and forest work in Northern Russia, comprising the Governments of Olonetz and Archangel, the principal seat of the timber trade ; in Central Russia, the north agricultural zone, in which are situated many of the mines ; in Eastern Russia or Siberia, extending from the Ural Mountains to Kamschatka ; in Southern Russia, including the Steppes, the Crimea, and the Caucasus ;

and in Western Russia, comprising Poland, Lithuania, and the Baltic provinces of Livonia ; the whole supplying illustrations of practical working of *Jardinage*, of *à tire et aire*, of *les compartiments*, and of *reboisement* and silviculture. There follows a general survey of forestry in Russia, in which are given details in regard to the distribution of forests, and of different kinds of trees, the economic uses to which their products are applied, the relation of the total annual production to the total annual consumption of wood, the Forest Administration, the Forest Code, the Forest Society, and the Schools of Forestry, and the forest literature of the country.

XIV.—*Translation of a Report on the Forests of Greece, and their Products, by Professor Theodore Orphanides, of the University of Athens.*

There are given in this Report information in regard to the extent of forests in Greece ; the different kinds of trees of which they are composed ; and their economic products. And there is superadded some notices of forests in Turkey.

XV.—*Sylviculture and Forest Management in the Austrian Empire.*

This comprises details of extensive works on the sand-drifts of the Bannat in Hungary, of the natural history of these, of the legislation for which they have given occasion, with notices of Hungarian literature on the subject of sand-drifts ; details of observations made in connection with works of hydraulic engineering to effect a rectification of the course of the Danube ; details of extensive works of *réboisement* in the Karst, a district on the coast of the Adriatic, undertaken with a view to counteract disastrous desiccation which has followed the destruction of forests ; and details of successful forest management, with a glance at the forest lands of Austria, and the arrangements followed in the Royal and Imperial School of Forestry in Vienna.

XVI.—*Forest Administration in Bavaria.*

Trained and instructed administrators and officials being required to carry out forest operations judiciously and efficiently, the Forest administration of Bavaria has been selected as illustrative of the forest administration of Germany, and detailed with annotations suggested by a discussion

now in progress in France on the Forest administrations of that country. Details are given in regard to the organisation of the forest service, and the training and instruction of forest officials, with information in regard to the schools of forestry at Aschaffenburg and in Munich; the functions of forest officials in State forests, in forests belonging to communities and corporations, and to private individuals; the forest legislation of the country; matters pertaining to the chase; and matters pertaining to sales of wood, and of other forest produce.

XVII.—*Réboisement and Forest Management in the Alps.*

Information is supplied in regard to the *réboisement* of the French Alps by the planting of mountain basins with trees, shrubs, and herbage, as a means of arresting the destructive consequences of torrents, and the formation of new ones; in regard to the management of forests in Switzerland, and the instruction in forestry given in the Polytechnicum at Zurich; and in regard to the evil effects of depasturing forest lands; with notices of forests and forest management in the Austrian Alps.

XVIII.—*Forest Economy, Irrigation, and Sylviculture, in Italy.*

Information is supplied in regard to the forests of Italy; the School of Forestry at Valambrosa; the forest legislation of Italy; extensive irrigation works in the north of Italy; and plantations of the *Eucalyptus globulus* in the south.

XIX.—*The Aridity of Spain: its Causes and Remedies.*

The aridity of Spain is attributable primarily and chiefly to the situation and contour of the country, but secondarily greatly to the destruction of forests. Existing forests are described; details are given of a struggle to prevent a threatened extensive destruction of these being carried into effect; of projects, or proposals of extensive replenishing, and of extensive works of irrigation being executed. Information is supplied in regard to the literature of forest science in the country; in regard to the Merino sheep, and the injurious effects of the *mesta*; in regard to sericulture, wine making, fruit, esparto grass, and other vegetable products of Spain; and in regard to the ethnography of the Spanish people.

XX.—*Meteorological Effects of Forests.*

There is detailed the chemistry of vegetation, and it is shown that by this the humidity of the atmosphere may be increased, while by shade evaporation from the soil is prevented, and by roots and stems the superficial flow of water may be arrested, and that the general effect of forests is to produce a more equable distribution of rainfall, both in time and in space. The general and local effects of forests in equalising the temperature is next illustrated, with notices of the correlation of temperature and humidity in their meteorological effects. The effects of vegetation in replacing carbonic acid by oxygen, and of forests in preventing or arresting miasmata are described; and details are given of practical measures which have been adopted in different countries, with a view to secure more extensively for the benefit of man meteorological effects which may be produced by forests.

XXI.—*Application of Advanced Modern Forest Science to the Conservation, Exploitation, and Extension of Forests in India.*

There are given official reports of silviculture and forest management in the Presidencies of Madras, Bombay, and Bengal; in the North-West Provinces, in Simla, Ajmere, the Punjab, and Oude; in the Central Provinces, in Berar, Hyderabad, Mysore, Courg, Burmah, Assam, and Ceylon."

Measures which I approved were adopted by Dr. Hough to carry out the suggestions submitted in my letter; but occurrences, which it is not necessary to detail, prevented effect being given to his arrangements; and the offer made by me lapsed. But I am equally ready now as then to carry through the press any one or any number of the treatises mentioned on the terms stated; and I shall feel grateful for any assistance which may thus be given me in making available for others the information I have compiled. I have drawn upon the mass of this material for a number of popular works, published in connection with the International Forestry Exhibition, held in Edinburgh in 1884; but the remainder, or any portion of it, is forthcoming if it be desired,

The treatises mentioned in the preceding pages were designed to be of a character sufficiently popular to be interesting to any one desirous of information on the subjects to which they severally refer; but I consider something still more popular might be useful in awakening an interest in such studies; and I question whether, if a School of Forestry were established soon, there exists amongst young men so diffused an interest in forestry as would induce many to avail themselves of the provision for study which such an institution would supply.

In view of this contingency, when it was resolved in the spring of 1883 to promote an International Forestry Exhibition in Edinburgh, as a means of promoting a movement for the establishment of a National School of Forestry in Scotland, I submitted to the projectors, through one of their number, for consideration, one measure whereby to some extent young men, such as those to whom I have referred, might have been interested in the matter, and prepared afterwards to judge intelligently whether or no they should take advantages of provision which might be made for imparting systematic instruction in forestry. Another measure, seemingly similar, but essentially different, was ultimately resolved on and carried out. When this was resolved on, I wrote to one of the projectors:—

‘I am very glad you have secured lectures from foreign students of Forest Science, but I consider that in order to secure from the Exhibition all the good possible, it is desirable to combine with these such lectures as I suggested.

‘I would state my argument thus:—In Denmark there is great interest in Archæology manifested even by the peasantry. This is attributed to Professor Thomsen, M. Worsaae, and others, men of the highest attainments in antiquarian lore, having, on holidays and at other times, joined little groups of country peasants in the Museum, and accompanied them on their rounds, directing their attention to what was interesting, and explaining to

them the teachings of different objects. While the second International Exhibition was being held in Paris, there was held an International Congress of Botanists, which I attended. And at specified times members of this Congress from different countries attended the former to give explanations of the articles exhibited from the countries whence they came. Similar arrangements in connection with the British Museum and the Royal Academy have been advocated by the Rev. H. R. Haweis, the Rev. Chas. Kingsley, and others. The measure which I have proposed is a modification of this adapted to our circumstances; and I anticipate it would frequently lead to adjournment to the Exhibition, attracting others who would cluster round to hear what was being said. At Forestry Exhibitions which I have attended in Paris, in Vienna, and in St. Petersburg, again and again I have seen students of Forestry take in at a glance the teaching of some object exhibited; and some one, to whom the subject was new, with catalogue in hand, try laboriously to spell out that teaching; and others simply pass through the compartment as if they felt they ought to see every thing, but had no interest in the objects there. I deem it of importance that these should be interested, that the enquirer should be supplied with the information he is desiring, and that the information possessed by the advanced student should be utilised for the instruction of the others; and all this might thus be done. Not only are the panoramas exhibited in the country accompanied by a lecturer, but the menageries have some one to go round and tell the names and the characteristics of the different animals, and the crowd crushing after him, and the pennies with which he is rewarded, tell how much his few words have added to the enjoyment of the visitors.

‘Should any such arrangement be made, I think it expedient that each lecture should be printed and sold on the day after delivery, in order that any attending one lecture may be able to purchase copies of any or all of those previously delivered. A half-hour’s lecture of 5000

words would fill 16 pages—the printing of which, with a cover, would cost for 1000 copies, 45s. If 500 copies of each were sold this would cover the expense of printing; and there would be secured the distribution, by sale, of 3000 tracts on forestry a week, to be dispensed over the country, with this beneficial result amongst others. The difficulty, I anticipate, to be encountered in maintaining at first a School of Forestry, is not in getting teachers but in getting students; and by such a distribution of tracts the subject will come under the notice of a great many more young men, and their parents or guardians, than at present.'

Nothing having come of this proposal, and the Exhibition being closed without provision being made for the continued exhibition of articles made available for the purpose, I addressed, under date of 23rd October, 1883, a letter to the Council of the Scottish Arboricultural Society, of which the following is a copy:—

'GENTLEMEN,

'I am informed that at last meeting of the Society it was resolved, amongst other things, that you should be instructed to take into consideration the expediency of getting prepared and published some simple treatises on subjects pertaining to forestry.

'I am, as you are probably aware, carrying through the press a series of works on forestry for which there is no such demand as would remunerate a publisher, towards which enterprise the Society last year contributed £10. I enclose tables of contents of those volumes which have already been published. I have now in the press one 'On the Forest Lands and Forestry of Northern Russia.' I contemplate following this with others 'On the Schools of Forestry in Germany,' 'On the Modern Forest Economy of France,' the adoption of 'Modern Forest Economy in Sweden,' 'Scientific Sylviculture in Denmark,' the adoption of 'Forest Management in accordance with Modern Forest Science in South Africa, in Australia, and in India,'

&c., &c. The expense of the execution of this enterprise will be far beyond the amount of money I can spend upon the work ; and I am prepared to accept from any quarter assistance in the undertaking in any form, and under any conditions which may be agreed upon.

‘ But irrespective of this, on the assumption of the correctness of the information I have received in regard to the resolution of the Society referred to, I desire to state that I am prepared, if you will meet the expense, to carry through the press, on such arrangements, as may be agreed upon, for distribution next year, monthly, among all members of the Society a series of *brochures* on any twelve subjects which you may select from a list which I send enclosed, each pamphlet to consist of 48 pages, and the issue to commence on the 1st or the 31st of January, as may be found most convenient.

‘ I believe that an edition of 1000 copies of each, similar in every respect to the volumes I have already published, may be printed for £6, or with a cover for £6 6s ; the postage of each copy would be a half-penny ; and should the enterprise prove satisfactory, it might, by subsequent arrangement, be continued in succeeding years, till the list be exhausted.—I am, &c.’

The following is a copy of the list of subjects appended to the letter :—

1. Forestry in England in the Nineteenth Century.
2. The Caledonian Forest ; and Early Sylviculture in Scotland.
3. Forest Laws of Ireland, and Modern Sylviculture in that Country.
4. Scientific Management of Forests in Australia.
5. Forests in Tasmania, and Economic Management of them.
6. Forestry in New Zealand.
7. Reckless Waste in Exploitation of Forests at the Cape of Good Hope, and the adoption there of the advanced Forest Economy of the day.



8. Destruction of Forests by Fire in South Africa ; and consequences which have resulted from this.

9. Forests in Natal,

10. Forests in South Africa, between the British Colonies and the Zambesi.

11. Adoption of Advanced Forest Economy in India ; and the results.

12. Exploitation of Forests in Honduras and British Guiana.

13. Forests in Nova Scotia and New Brunswick.

14. Forests in Lower Canada.

15. Forests in Upper Canada.

16. Forests in Manitoba.

17. Forestry in the United States of America.

18. Arbor Day in America, and Sylvicultural Operations there.

19. The Training of Forest Officials for Forest Service in India.

20. A School of Forestry for Britain.

21. Ancient Forests of Europe.

22. Remains of successive Forest Trees which have grown in the locality, and been preserved in Peat Bogs in Denmark.

23. Fossil Remains of Pre-Adamic Trees in Northern Europe.

24. Norway and its Forests.

25. Clearing of Forest Land for Agriculture in Finland, with Notices of its Forest Scenery.

26. Forest Exploitation, by *Jardinage*, in Northern Russia.

27. French Forest Ordinance of 1669.

28. Development of Modern Forest Economy in Saxony.

29. Schools of Forestry in Germany.

30. Adoption of Advanced Forest Economy in France.

31. Sylviculture in France in accordance with the Advanced Forest Economy of the day.

32. Scientific Sylviculture in Denmark.

33. Adoption of Modern Forest Economy in Sweden,

34. Forest Operations in the Mining Districts of Eastern Russia.

35. Sylviculture on the Steppes of Southern Russia.

36. Forestry in Poland and Lithuania.

37. Forestry in Hungary, and the Arrest of Drift Sand in the Bannat.

38. Forestry in Austria, and the Replanting of the Karst with Trees, with a view to counteract the desiccation which has followed the destruction of trees there.

39. Switzerland, and the Replanting of Trees on the Alps to prevent the occurrence of torrents and inundations.

40. Italy, and the Planting of its Marsh Lands with the *Eucalyptus*, to counteract malaria.

41. Spain : the Causes or Occasion of its Aridity, and the Remedial Measures which are being adopted, including the Conservation and Extension of Forests.

42. Algiers, and adjacent countries on the Southern Coast of the Mediterranean, and the Extensive Planting Operations which are being carried on there.

43. Former Forests of Palestine.

44. Forestry in Turkey and Greece.

45. Forests and Moisture.

46. Natural History of the *Eucalyptus Globulus*, or Blue Gum, its properties, and effects produced by the cultivation of it.

47. Tree Culture on the Sand Plains of Northern Europe, with Notices of the Composition of Sand.

48. Manufacture of Wood Pulp, and uses to which the product is applied.

This offer, also, I renew, and in doing so extend it to any who may be disposed to co-operate in the execution of such a scheme—publishers or others, including editors or proprietors of periodicals who may see their way clear, in accordance with a practice more prevalent on the Continent than in Britain, to append such *brochures* to the successive issues of their publications, taking this into account in the price charged.

V.—PROFERRED GIFT OF WORKS ON MODERN FORESTRY  
TO FREE PUBLIC LIBRARIES IN ANY OF THE BRITISH  
COLONIES, AND IN ANY OF THE UNITED STATES  
OF AMERICA.

While a British National School of Forestry might be made available for instruction in Modern Forestry to any party who may desire this through the medium of the English language, I know of no insuperable difficulties in the way of such institutions being organised in any of the States of the American Union, or in any of the Colonies of the British Empire, in connection with existing educational arrangements of their own. As a contribution of information, which might be of use to any residents in these, in determining what might be done in the matter, I am prepared to deliver free, to any address in Edinburgh or London, which may be given to me, a copy, in sheets, of any or all of the following works, to be placed in a Free Public Library in any of these States or Colonies, on an application to me certified by the Government of the State or Colony.

1. Origin and History of Schools of Forestry in Germany, with Addenda relating to the Desiderated School of Forestry in Britain—*This volume.*

2. The School of Forest Engineers in Spain, indicative of a type for a British School of Forestry.

3. Introduction to the Study of Modern Forest Economy.

4. French Forest Ordinance of 1669, with historical Sketch of Previous Treatment of Forests in France.

5. The Forests of England, and the Management of them in by-gone times.

6. Forestry of Norway.

7. Finland—its Forests and Forest Management.

8. Forestry and Forest Lands in Northern Russia,

9. Forestry in the Mining Districts of the Ural Mountains in Eastern Russia.

10. Forestry in Poland, Lithuania, and the Baltic Provinces of Russia.

11. Pine Plantations on Sand Wastes in France.

12. Reboisement in France; or Records of the Replanting of the Alps, the Cevennes, and the Pyrenees, with Trees, Herbage, and Bush, with a view to arresting and preventing the destructive consequences of torrents.

13. Hydrology of South Africa; or Details of the former Hydrographic Conditions of Cape of Good Hope, and of Causes of its Present Aridity, with Suggestions of Appropriate Remedies for this Aridity.

14. Water Supply of South Africa, and Facilities for the Storage of it.

15. Forests and Moisture; or Effects of Forests on Humidity of Climate.

The editions of some of the works are nearly exhausted, and I deem it expedient to reserve a limited supply of each for any demand which may arise for them in Britain; but subject to this limitation, copies of all will be sent to early applicants in the order in which their applications may be received.

In some States or Colonies there may be more than one Free Public Library to which such a grant might be acceptable. To any such certified by the Government, subject to the limitations which have been stated, I am ready to send copies of Nos. 1, 2, and 3, and copies of selections from the others, determined by the greater or less numbers of them which may happen to remain in stock. The expenditure which I have already incurred, is my excuse for not offering to deliver the copies bound; but arrangements have been made according to which any may be bound here at a uniform charge of sevenpence per volume; and I shall hold myself bound by this proffer for six months from the date of publication of this volume.

VI.—MATTERS PERTAINING TO SCHOOLS OF FORESTRY, ON WHICH THE AUTHOR IS READY TO SUPPLY INFORMATION TO ANY GOVERNMENT OFFICIAL, PUBLIC ASSOCIATION, OR PRIVATE INDIVIDUAL, DESIROUS OF ESTABLISHING A BRITISH NATIONAL SCHOOL OF FORESTRY :—

1. The need of scientific training in forestry for the administration of indigenous forests in British colonies.

2. The difference between British Forest Economy and what is required for such forests.

3. The advantages of scientific training for British Foresters.

4. The origin and development of Schools of Forestry.

5. The instruction in political economy and jurisprudence given in Schools of Forestry on the Continent.

6. Stations for Experimental Research attached to several Schools of Forestry on the Continent.

7. The extent to which a British School of Forestry should be conformed to the model of such Schools on the Continent of Europe.

8. The expediency of combining with such, facilities for research, and the expediency of including in these carpenters' workshops, &c.

9. Where an eligible site for a British National School of Forestry might be found, irrespective of the contiguity of a forest.

10. What eligible arrangements could be made in Edinburgh if this were made the site of a School of Forestry?

11. The advantages and disadvantages of a School of Forestry founded by private enterprise.

12. The advantages and disadvantages of a Professorship in a University.

13. The advantages and disadvantages of a Class for the Study of Forestry in the Watt Institute in Edinburgh.

14. The special advantages of forming a School of Forestry in the Museum of Science and Art under the Committee of Council on Education, in Edinburgh.

15. The salaries paid to instructors in Schools of Forestry on the Continent.

16. The entire expense of some existing Schools of Forestry.

17. The curriculum of study appropriate for a British School of Forestry.

18. Where qualified Teachers might be found, and salaries which might be offered to such.

19. What has been done of late years, and what previous endeavours have been made to secure the establishment of a School of Forestry in Britain.

20. What has been done to originate some small classes for the study of Forestry.

21. What has been done of late years to introduce the study of Forestry, &c., into Primary Schools.

22. What has been done through the Press to make known Modern Forestry.

23. What has been done to raise money to establish a School of Forestry.

24. The propriety of spending State funds on the establishment of a British National School of Forestry.

THE END.

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SCHOOL  
OF  
FOREST ENGINEERS  
IN SPAIN.



SCHOOL  
OF  
FOREST ENGINEERS  
IN SPAIN,

INDICATIVE OF A TYPE FOR A  
BRITISH NATIONAL SCHOOL OF FORESTRY.

COMPILED BY

JOHN CROUMBIE BROWN, LL.D.,

*Formerly Lecturer on Botany in University and King's College, Aberdeen ;  
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of Botany in the South African College, Cape Town ; Fellow of the  
Linnean Society ; Fellow of the Royal Geographical Society ; and  
Honorary Vice-President of the African Institute of Paris.*

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EDINBURGH :  
OLIVER AND BOYD, TWEEDDALE COURT.

LONDON : SIMPKIN, MARSHALL, AND CO,

1886,



## P R E F A C E.

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IN the spring of 1877 I published a brochure entitled : *The Schools of Forestry in Europe : a Plea for the Creation of a School of Forestry in Connection with the Arboretum at Edinburgh*, in which I submitted for consideration the opinion that with the acquisition of this Arboretum, and with the existing arrangements for study in the University and in the Watt Institution and School of Arts, there are required only facilities for the study of what is known on the Continent as Forest Science to enable these Institutions conjointly, or either of them with the help of the other, to take a place amongst the most completely equipped Schools of Forestry in Europe, and to undertake the training of foresters for the discharge of such duties as are now required of them in India, in our Colonies, and at home.

On the 15th of May, 1885, it was ordered by the House of Commons that a Select Committee be appointed to consider whether by the establishment of a Forest School or otherwise our woodlands could be rendered more remunerative. By this Committee valuable evidence was collected, and on the 24th of July they agreed to the following report :—“ Your Committee are of opinion that at this late period of the session it will not be in their power to conclude their investigation ; they have there-

fore agreed to report the evidence already taken to the House, and to recommend that a Committee on the same subject should be appointed in the next session of Parliament." And this was done; but in like circumstances, and with like result. Meanwhile, at the meeting of the British Association for the advancement of science held in Aberdeen in the autumn of the year, the general Committee of that body adopted a resolution that Sir A. Taylor, Professor Bayley Balfour, Dr. Croumbie Brown, Dr. Cleghorn, and Sir John Lubbock, be a Committee for the purpose of considering whether the condition of our forests and woodlands might not be improved by the establishment of a forest school.

I was called to give evidence before the Committee of the House of Commons appointed last summer to consider this matter. In reply to a query then put to me I stated, amongst other things, that I could not name any School of Forestry which I could propose as a model for a School of Forestry which would meet the wants of Britain, but that the School of Forest Engineers in Spain was one of a type which might be followed with advantage in the organisation of a British National School of Forestry if it should be determined to establish one in Edinburgh, which offered special facilities for the establishment of such a School.

The following compilation has been made to illustrate what is implied in the opinions which I then expressed.

I adhere to these opinions, but I consider that valuable suggestions which might be utilised in the organisation of a British National School of Forestry may be derived from a knowledge of what arrangements exist in other Schools of Forestry on the Continent of Europe than

that specified; and I have prepared for the press a companion volume on the Schools of Forestry in Germany, the Fatherland of Modern Forest Economy, and the land in which Schools of Forestry originated. In this I have given accounts of the Schools of Forestry in Saxony, Prussia, Hanover, Saxe Weimar, Hesse Darmstadt, Baden, Wurtemberg, and Bavaria; with notices of an exhaustive discussion of the relative advantages of having a School of Forestry in the country in immediate proximity to a forest in which the students might be exercised in forest operations, or of having it established in connection with a University, or some similar seat of learning; and of stations for experimental research and observation established at the sites of Schools of Forestry.

In connection with this intimation I may mention that in the Plea, &c., to which I have referred, I have given notices more or less extended, of the existing Schools of Forestry in Russia, Saxony, Hanover, Hesse Darmstadt, Wurtemberg, Bavaria, Austria, Poland, Russia, Finland, Sweden, France, Italy, and Spain.

In the *Journal of Forestry* information is given in regard to the course of study followed at Hohenheim, in Wurtemberg, vol. i., pp. 81-87; at Carlsruhe, in Baden, pp. 394-398; and at Evois, in Finland, pp. 545-551, 701-707. In regard to this last, details are also given in a volume entitled: *Finland: its Forests and Forest Management*. In a similar volume entitled: *Forestry of Norway*, information is given in regard to instruction in Sylviculture given in the Agricultural School at Aas; and in one entitled *Forestry in Poland, Lithuania, and the Baltic Provinces of Russia*, are given the code of regulations

prescribed for the institution of Agriculture and Forestry at Novoi Alexandra.

It is my belief that a light will be found thrown upon any or all of these notices of Schools of Forestry if the reader have, previous to the examination of them, glanced at a volume published by me entitled : *Introduction to the Study of Modern Forest Economy* ; and in connection with this, another entitled *French Forest Ordinance of 1669, with Historical Sketch of Previous Treatment of Forests in France*.

JOHN C. BROWN.

HADDINGTON, 10th September, 1886.



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Page 167.—By later information, I learn that now the allowance for travelling expenses is to students 40 reals, or 8s, and to professors 100 reals, or £1 a-day, when on excursions.

# SCHOOL OF FOREST ENGINEERS IN SPAIN.

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## CHAPTER I.

### ORIGIN OF A CORPS OF FOREST ENGINEERS IN SPAIN.

THE treatment of forests in Spain for many ages seems to have differed little from that of the treatment of forests in other countries, differing chiefly in this: for while in many other lands the disposition to practice a wasteful destruction of forests was to some extent held in check by measures adopted by kings and nobles to secure for themselves what are called the pleasures of the chase, and this leading them to punish unmercifully the destruction by others of trees which afforded covert for their game,—this does not seem to have been the case, or the case to the same extent, with the successive rulers of the Peninsula, who were all of them of different races from the later conquerors of Central Europe.

The present endeavour to secure the conservation, economic exploration, improvement, and so far as practicable and expedient the replenishing and extension of existing forests in Spain may be said to have originated, or taken a fresh departure in the issue of General Ordinances in reference to these in 1833. There had been previous legislation in regard to the forests; and some of the laws and official instructions which had been issued were not unimportant. Among those deserving of notice are such issued by Don Fernando and Donna Isabel in 1496, and others by Don Carlos I, and Donna Juana in 1518. And a memoir on

the then state of agrarian law by the illustrious Jovellanos, published towards the close of the last century, made manifest the necessity which there was for a development and improvement of the agricultural capabilities of the country, and arrest of the bad administrative management to which were being subjected the extensive but fast disappearing masses of the public forests. It was published originally in 1796; successive editions appeared in 1814 and 1820, and yet another edition followed in 1834. It is entitled *Informe de la Sociedad Economica de Madrid, al Real y Supremo Consejo de Castilla, en el Expediente de ley Agraria Extendido por su Individuo De Numero de Melchor Gaspar de Jovellanos a Nombre de la Junta Encargada de sa Formacion y Con Arreglo a Sus Opiniones.*—‘Statements of the Economical Society of Madrid to to the Royal Council of Castile in regard to the Agrarian Law, prepared by one of their number in the name of a Committee charged with the work, and in accordance with their views.’

The edition of 1820 is considered the most trustworthy of the earlier editions, as it was prepared under the auspices and direction of the Economical Society, following most scrupulously the original, corrected by the author, so as not to reproduce inaccuracies which had appeared in other editions.

Amongst points discussed, which relate more immediately to forestal matters, are those connected with commons, lands belonging to communal councils, and public forests, which, with some trifling exceptions, it was at that time considered would be best protected from destruction by their passing into the hands of private proprietors.

It is a prevalent opinion amongst students of forest science that while coppice woods may be exploited by private proprietors, without detriment to public interests, timber forests, and more especially timber forests from which are expected trees of very large growth, can only be satisfactorily administered by the State. It has thus come to pass that importance has been attached as a point of

some interest, to what were the views of Jovellanos on this matter.

In a Catalogue Raisonné prepared and printed for private circulation, by Ilno Sr. Don Jose Jordana y Morera, of upwards of eleven hundred books, MSS. and charts in Spanish, original or translated, bearing upon forest science, the author writes thus of a treatise included in a collection of published works by Don Gaspar Melchor de Jovellanos, entitled *Representacion de la Villa de Gijon para que se prorogue el arbitrio de vino y sidra para Fuentes, Calles y Plantios*:—‘For this work we are indebted to the illustrious author of the *Informe Sobre La Ley Agraria*, which, notwithstanding its unpretentious appearance, is one of the greatest importance in determining precisely what were the opinions of that enlightened patriot in regard to the nature, the advantage to the country, the utilisation, and the possession or tenure by the State of the public forests, in regard to which many, misled it may be by the brevity or conciseness of his statements, have supposed that he spake doubtingly, rather than with certainty, in regard to the question of the absolute and entire alienation or sale of the forest possessions of the country. From the text of the *Representacion* it is apparent at least that his opinion did not go so far as this, but rather that on the contrary he assigns to public forests advantages, and a utilisation of a national character impossible to be obtained from forests held only in the interest of a private proprietor.’ And he remarks in regard to the *Representacion*:—‘One of the most noteworthy paragraphs in it is the following:—Nor is less certain the necessity of creating on the approach to this town a plantation of pines on the extensive sand plain stretching away to the east and the south, the sand composing which is kept in continuous movement by the wind, enters the streets and accumulates in them, obstructing and embarrassing the public way to the great trouble of passengers, and the great discomfort and annoyance of the inhabitants,

‘It is the case that with a view to remedy this evil there have been constructed protective banks, in regard to which this town addresses a separate representation to your Highness ; but much more important would be such a plantation of pines as has been spoken of which would be productive of two great benefits—one arresting and breaking the force of the winds, and the other clothing and solidifying the ground, delivering this beautiful town for all time coming from an enemy which has been destructive to it in many ways, and proportionally producing an abundance of wood so necessary at the entrance to a port which has its little shipbuilding yard, where are being constructed continuously boats, pinaces, launches, and other vessels used in fishery and commerce.

‘This is the more desirable because it would lead the town to extend other plantations in its immediate vicinity, for which it holds lands more extensive and well adapted for the purpose than may be imagined, affording protection to the new highway which is being constructed by orders of his Majesty ; and giving shade to the new promenade and canals of the Humedal, made by permission of your Highness ; and crowning with trees the forest of Santa Catalina, which protects this coast town on the north.

‘All of these plantations, and many others which might be made in the vicinity of this town, were proposed to our Town Council by our compatriot D. Gaspar Melchor de Jovellanos.’

It has been for many years past a subject of keen controversy, I may say of bitter dispute, between the Government and the students of forest science in Spain, whether it would tend to the saving or the ruin of the country to alienate the State forests, which, it is alleged, would almost certainly issue in the destruction of them ; and it supplies to the opponents of alienation a sentimental satisfaction to find that Jovellanos, to the publication of whose *Informe Sobre ley Agraria* is attributed the modern development of forest science and forest economy in Spain, of whom it had been alleged that he was opposed to their views, was



really at one with them. What however chiefly interests us is that this work of Jovellano's marks the rise of the present interest in forestry manifested in Spain.

In a work by Sr. Don Francisco Garciao Martino, entitled *Los Montes y el Cuerpo de Ingenieros en las Cortes Constituyentes*—the Forests and the Corps of Forest Engineers in the Cortes and Legislative Assembly, the author, having referred to the work, proceeds:—‘The well-remembered *Informe Sobre ley la Agraria* of the distinguished Jovellanos produced a profound sensation in the beginning of the present century amongst the illustrious men of the country who realised the necessity of developing more fully the productions of our soil. The doings denounced in that celebrated document, with impregnable proofs of the vices inherent in the administrative management of our public forests, led to the serious consideration of that department of spontaneous products, which, with the abrogation of certain ordinances relative to the marine trade, were left abandoned and at the mercy of interested persons, and the ever-increasing pecuniary necessities of the municipal proprietors. Under the inspiration of the views of Jovellanos, they broke the fetters which prevented liberty being enjoyed by agriculture. Thus was extended its sphere of action; but under the pretext of convenient, useful, and even necessary forest clearings, there were committed such abuses in the forests, and our best forest masses were felled in such a way that the Government saw itself under the necessity of legislating anew in regard to forest property, and of doing so in accordance with the prevailing views of the day. Reformed France and cultured Germany set the example of restraining and repairing destructions which ignorance and administrative errors on the one hand, and wars and political confusion on the other, had produced in their forest riches.’

Sr. Martinos, in his introduction to this work, having

alluded to the important measures which had been previously adopted with a view to the development of the agricultural capabilities of Spain, to the good service which had been done by the several corps of engineers, and to what more might have been done, writes:—‘The law of the 22nd December, 1833, promulgating the general ordinances relative to forests, recognised the fact of the progressive destruction of these, and to meet them created a General Directory, to the charge of which were committed all those denominated public forests. The Admiralty lost then all the privileges it had previously exercised in regard to inspection, marking and appropriating trees. This was a reasonable and just arrangement; but on the other hand the interests of the State were doomed by the limitation in Art. 24 that no other proofs will be admitted beyond authentic titles of proprietorship and uninterrupted possession for more than thirty years; which is a period far too brief in a matter pertaining to lands without fixed boundaries, and abandoned from remote times. Moreover, while there is manifested an interest in the proper regulation of this branch of the service in these ordinances, comprising in all 236 articles, of arrangements in regard to administration, conservation, sales, felling, utilization, policy, legal proceedings and penalties, there is apparently a lack of sound doctrine and of special knowledge of the matter in hand. It is a collection of practical rules, some of them contradictory and others impracticable, but they tended, beyond all doubt, to restrain abuses by imposing severe penalties for these. It is an almost literal translation of the French code, applied without sufficient study to our country; it opened the door to great abuses; and it was the occasion of no small destruction of the riches, the conservation of which it was designed to secure.’

What was now felt to be of imperious necessity was that those employed in this department should possess the requisite special knowledge. To meet this it was there

were issued special decrees on the 30th April and on the 1st May, 1835. It was said in Art. 7 of the former:—‘There shall be created in the corps of the civil engineers other two bodies (besides those of roads and of mines), geographic engineers and woodland forest engineers, so soon as the formation of primary schools of both shall admit of their being established.’ The second postpones till the 1st of October following the creation of a special school for forest or woodland engineers, under the direction of the inspector of forests, Don Sandalio de Arices; and in Art. 7 it says:—‘When it shall be the case that there shall be created a corps of woodland or forest engineers, the director of the school shall be assigned rank and position in this, with due consideration of the services which up to that time he may have rendered.’

The civil war, and other matters of greater importance demanding attention, prevented the realising of this patriotic purpose at this time. But subsequently both purposes were carried out; and in studying the general question of forestry in Spain we find that the development of the School of Forestry, *La Escuela especial de Ingenieros de Montes*, and that of the corps of forest engineers, *Cuerpo de Ingenieros de Montes*, were concurrent, each reacting upon the other, the instruction and training received in the school qualifying the members of the corps to make a progressive advance in the discharge of their professional functions, and this making new demands on the teachers of aspirants for such appointments. Thus, in marked parallelism, may be observed what is stated in regard to the development of the School of Forestry in a work by Sr. Don Carlos Castel y Clemente, entitled *Noticia Sobre la Fundacion y Desarrollo de la Escuela Especial de Ingenieros de Montes*: Notice of the Foundation and Development of the Special School of Forest Engineers, and in the arguments of the treatise by Sr. D. Francesco Goercia Martino, entitled *Los Montes y el Cuerpo de Ingenieros en los Cortes Constituentis*.

## CHAPTER II.

### ORIGIN AND DEVELOPMENT OF THE SCHOOL OF FORESTRY.

THE *Cuerpo de Ingenieros de Montes*, or Spanish Corps of Forest Engineers, is recruited exclusively from the School of Forestry, *Escuela Especial de Ingenieros de Montes*.

Such a school was instituted by decree of the 1st May, 1835; but many modifications were subsequently made in the arrangements and organisation, more especially in 1843 and 1846, when the school acquired something of the development which it now presents as a State institution under the Minister of public works and the Director General of public institutions. It was for a considerable time located at Villaviciosa d'Odon, near Madrid; but in 1869 it was transferred to one of the buildings pertaining to the palace of the Escorial, not far from the Sierra Guadarama, about two hours' distance by rail from Madrid. To Sr. Don Carlos Castel y Clemente we are indebted for much information in regard to the early history of the diffusion of forest science in Spain by schools of forestry. In the latter end of 1876, in accordance with instructions given to him, he undertook to collect information which might serve as the basis of a memoir on the subject; and in the following year the substance of this was published by him in a brochure entitled *Noticia Sobre la Fundacion y Desarrollo de la Escuela Especial de Ingenieros de Montes*, in the introduction to which honour was done, as was most meet, to Sr. D. Bernardo de la Torre Rojas, founder, and for many years Director of the first school of forestry in Spain, the acknowledged 'father of the Spanish School of Forestry.'

After sketching briefly the reckless destruction of forest

wealth in Central Europe in byegone times, to arrest which was again and again attempted by legislation in France and other countries, but with little effect, he refers them to what was done in Germany:—

‘In the seventeenth century originated in some of the States of Germany the application of technical science to the treatment of forest masses. The rules, the aphorisms, and the whole of the directions which are compressed in the forestal knowledge of the ancients, are principles indefinite, obscure, uncertain, unconnected, destitute of method or systematized relations. Moser created in 1757 the first body of systematic teaching on the subject; and to the impulse given to this by him, and the weighty energy of Langen, Laspar, Zanthier, and others, are we indebted for the formation of the first plans of scientific treatment of forests begun in 1731 in the forests of the Dukedom of Brunswick. He, in his time, Langen having been the first to do so, perceiving the necessity of entrusting the management of the forests to a specially educated and trained body of officials, possessing all necessary knowledge and information, with a view to raising up a body of such men, established the first school of forestry in Wernigerode in the year 1772. But others consider as the first school that founded by Zanthier in Ilsenberg, which was followed some years later by the establishment of that by Haase in Lauterberg, that which G. Hartig founded in Hungen in 1791, that founded in Zillbach by H. Cotta in 1795, and various others, all due to the efforts of individuals, and manifesting that essentially practical character which was so requisite to meet the requirements of the time and the conditions in which the distinguished founders were placed, but they lacked means which would allow of there being given to them the influence and development which became needful.

‘Contemporaneously with the schools there were produced also new methods, or systems of exploitation; and the names which have been cited are those of men who proved authorities of the highest rank, who have opened

up new paths in forest study. For me it is impossible, nor does space permit me, to produce a chronological and critical narrative of the principal phases through which the newborn forest science passed in its evolution and successive development; fresh in the memory of many in Spain must be the remarkable articles written under the title, *Sistemas Forestales*, by the erudite Forest Engineer, His Excellency Sr. D. Agustin Pascual, the first Spanish writer on *dasanomy*, and formerly professor in our School of Forestry, to whom it is enough that I thus refer while passing on to state succinctly the new form, and report the multiplication and general organisation of forestal schools which occurred in Germany and in some other countries in Europe.

‘The primary organisation of the schools founded in Ilsenberg, Wernigerode, Lauterberg, Hungen, Zillbach, Waltherhausen, Rottenhaus, Castell, &c., in the period from 1766 to 1805, was that of several other private centres of instruction, which died out with their founders, or suffered the fate which befell these in the course of their existence. All these made themselves remarkable by the great impulse and development which they gave to the diffusion of forest science, and by their having raised up a numerous and distinguished body of men to assist and direct at a later time the work of bringing into order the forests of the districts in which they were situated. There stands out prominently amongst all these the school founded by Cotta. He, being charged with the reduction to an orderly condition of the forest of Fishbach, spent some years in the execution of this work, during these years giving theoretic and practical instruction to the young men who assisted him there: thus was instituted the new centre of forestal instruction of Zillbach. Such reputation was acquired by this establishment of modern times, that in 1795 there was granted to it a subvention from the State, by means which Cotta was enabled considerably to augment the means available then for the prosecution of study. In 1810 Cotta was appointed

Director of forest management in Saxony. He at once perceived and pointed out the lack which existed of a skilled staff of officials, who should execute and assist in the execution of his projects, and with a view to meeting this desideratum the forest school of Zillbach was transferred to Tharand in 1811, and was ceded to the Government on the 12th of May, 1816. Converted into a Government academy, and furnished with all necessary resources, the school of Tharand, devoted to the instruction of the forest engineers of the State, very soon flourished beneficially, attracting to study there the studious youth of many different countries, and serving as the sharp edge of a wedge for the general diffusion of those truths which, spreading themselves a little latter in different countries, proved the occasion of there being opened other schools which take pride in calling themselves daughters of the Saxon academy.

‘In their turn, in Austria and Russia—nations which, if they did not take the first step, followed at once the advancing march of the States of Germany—there had been organised Schools of Forestry; those in Austria having the character of a private establishment in the beginning, but those of Russia being Government institutions from the first. Amongst those, the first established—that founded in 1770 by Ehrenwerk in Rotherhaus, in Bohemia—continued till 1791. This was succeeded by another, established in the beginning of the present century in Krumau; and coincident with its appearance we meet with the schools of Eisgneb in Moravia, Eisgenstadt in Hungary, and Gratzen in Bohemia.

‘Passing from private seminaries to public and Government institutions, there were founded the schools of Datschetz in Moravia, and that of Plass in Bohemia, opened in 1823 and 1880, in which there is some Government intervention, but this is very limited. When the Government was once convinced—as was the case likewise with the Government of Germany—of the urgent necessity there was for entrusting the administration of

forests to a staff of officials endowed with special scientific knowledge, they arranged in 1805 the opening of a course of practical instruction in sylviculture in Purkersdorf, near Vienna; and subsequently, in 1813, increasing the staff of professors, and with a well-considered plan of instruction, this school was transferred to Mariabrun, not far from the capital of the empire. In 1827 the plan of study was changed, and the subjects of study were divided into four *semestres*, or half-year sessions; ultimately, in 1852, this was reorganised by distributing over three years the study of the different prescribed subjects which comprised the course followed by forest engineers.

Other schools exist in Austria, due—some to the initiation of private individuals, others to the action of provinces, and most to the exertions of forestal associations, which have increased in that country. Such, for example, is the school of sylviculture in Weisswasser, that in Aussee, that of Kreuz, and others.

A faithful imitator of Germany, and endowed with a great amount of practical spirit, Russia in the beginning of the present century introduced the forestal instruction imported from the academies which were founded years before by those who well merit the name of Fathers of the present forest science. The schools of Zarsko-Selo and Kafelskoy, created in 1803 and 1804, propagated the movement which was being initiated by the successful scholars of the German schools. These being reorganised in 1813, the school was removed to St. Petersburg, where, in 1829, the new school received the name of Forest Institute, and was some time later made more complete by the establishment of a school of practical forestry at Lissenoy. Russia has now additional schools, which may be reckoned amongst the means available for forestal instruction. These are called schools of the Steppes, amongst which, deserving special mention, is that opened in 1842 in Anadol, the highest lying and most barren spot in the Steppes of Ekatherinoslav; the primary object of which is to educate and train sylviculturists for the



management of steppe lands of that extensive district.

‘In regard to France, into which the ideas prevailing in Germany penetrated without difficulty, they then perceived also the necessity of entrusting the administration of public forests to a staff of officials possessed of a knowledge of the several departments of forest science; and, to secure this, they instituted in Nancy, in the year 1824, the school where the forest engineers thenceforward have received instruction. The first director of this school, M. Lorentz, having been educated at Tharand, the school was formed after the model of the earlier schools of Germany, and its organisation was accordingly similar to that of those schools; and it has long maintained a well-deserved consideration for the zeal, and energy, and work of its professors.

‘Such, in rough outline, is a sketch of the history of forestal instruction in Europe, reflecting the dominating ideas of different nations in which schools of forestry had been established, when first there was heard in Spain a voice with authority proposing to open for her also a road which might lead to the consideration and restoration of her diminished forest riches.’

Sr. Castel, in his treatise on the origin and development of the school, writes, in accordance with what has been stated in the preceding chapter in reference to the General Ordinance of 1833, cited in the preceding chapter, as issued to prevent a progressive devastation and destruction of forests in Spain. In reference to the General Ordinance of 1833, he says: ‘While these General Ordinances put an end to some vicious practices and privileges which could not be sustained, and created a General Directory, to the charge of which were committed all the forests now designated public, they did not break with the traditions and proceedings of established usage coming down from the olden times, manifesting a lack of special knowledge of the matter in hand, and great if not absolute

ignorance of the good doctrine which found its birth, some fifty years before in the schools of Germany, and had cast its dawning light upon the northern slopes of the Cordilleras of the Pyrenees.'

Two years later, by Royal decree of 30th April, 1835, it was established, that within what was called the corps of civil engineers, there should be established a department designated Inspector of Woods, so soon as the creation of the necessary school should admit of this being efficiently organised; and next day (1st May), there was prepared a Royal decree, according to which the said school of forest engineers was established in the capital of the kingdom, in October of the same year, under the direction of Don Antonio Sandalio de Arias.

The year, however, closed without the project being realised, and the subject might seem to be forgotten. But some years later a son of Cotta, who with Hartig founded the original school of forestry in Saxony, was invited by Senor Don Martin de los Horas, Intendente de la Real Casa y Patrimonio, to come and organise a scientific management of the forests of the Royal patrimony. He could not come; and to meet the more pressing requirements of the case two young men were sent, at the charges of the Royal treasury, to the forest academy at Tharand, to go through the course of study required of them as forest engineers; and on 16th March, 1843, there was issued by the Regent of the kingdom a decree ordering anew the establishment in Madrid of a special school of forest engineers, and practical schools of sylviculture, land surveying, and mensuration, in the provinces of Cuenca, Huesca, Jaen, and Santander. Along with this decree there were issued regulations for the schools, but like the first attempt to accomplish the same object this second proved abortive.

A Royal decree, issued on the 18th November, 1846, had, however, happier results, and on the 10th January, 1847, by Royal order, Senor Don Bernardo de la Torre Rojas was appointed Director of the projected school.

Regulations were prepared, and professors were appointed to give instructions in the school, and befitting premises, worthy of the school of sylviculture was found first in the ancient palace-castle of Villaviciosa d'Odon, a chaste and beautiful building erected in times anterior to the commune of Castile, destroyed partially on that account in 1520, and restored internally in the year 1584, according to plans by the celebrated Juan de Herrera, honoured of Spain, and the creator of many of her architectural treasures.

By a Royal decree of 18th August, 1847, the regulations were confirmed, and the school was opened on the 2nd of January, 1848, under the director and four professors, with a vice-director and assistant professor superadded. All of these are spoken of in terms of high commendation.

Villaviciosa was situated, as has been stated, some four leagues and a-half from Madrid. Senor Castel writes:—

‘If we advert to what has been said elsewhere in regard to the conditions of the place where the school was to be located, it may be remembered that according to the arrangements laid down in 1835 and 1843, it was required that the school was to be created in the Capital. The Royal decree of 18th November, 1846, is the first public document from which it appears to have been determined that the school of forestry should be established in some locality *near* to this—and in consequence—though the statement is but vague—away from Madrid, the centre of superior instruction in all Government civil careers, and in many of the military ones. It may be asked—what was it which determined this resolution, which was maintained in the Royal decree of 1847, and to which practical effect was given in appropriating for the purpose the palace-castle of Villaviciosa, in which the classes were opened on the 2nd January, 1848?’

‘Two principal arguments which suggest themselves at once as fundamental ones which may have weighed with the Government are these: The belief that a school of sylviculture would find its natural and appropriate place in the

midst of fields, and near to a forest where the practical application of the fundamental studies might be possible and easy; and the knowledge that there did not exist in the city a property with suitable buildings: this might make the acceptance of the offer of that building more easy for the founder than to take from the general funds an amount, necessarily large, for the construction and fitting up of premises destined for an establishment which in truth owed its birth more to the personal energy of one resolute person than to any spontaneous and creative interest taken in it by individuals occupying a prominent place in the administrative centres concerned.' And he proceeds:—

'We may here glance for a moment at the primary prerequisites of such an institution, and at the measure in which the castle of Villaviciosa met these, as these had led to the preference being first given to Madrid by Professor Don Maximo Laguna in 1866, and supported in his remarkable memoir, *Excursion Forestal por los Imperios de Austria y Russia*, he considering that from the particular character of the fields around Villaviciosa and, the insignificant population there, with the absence of all scientific appliances beyond those pertaining to the school itself, that place could not compete with Madrid as a site for a school of forest engineers, the slight advantage gained by facilities for practical instruction being eclipsed by the immensely greater facilities for scientific instruction presented by the numerous museums and libraries which enrich the capital of the kingdom.

'More weighty however, and determining, in my opinion, the ulterior decision, was the circumstance that within three leagues and a-half from the city was a magnificent palace, which could be had by the State at comparatively small expense, and on which necessary works of repair and adaptation could be executed at much less expense than the rents yielded by it—an immense benefit not easily to be met with elsewhere. And there the school was established in 1847, at least temporarily, as said Senor

Laguna, the most weighty reason being that it was now a question of—'To be or not to be. Before that question all the considerations which have been mentioned, and all others which might have been advanced, had to give way; nor could this be considered in any way a censure on the honoured founder, as the aforementioned Forest Engineer elsewhere remarks: "Bitter vexations always accompany him who initiates or attempts to carry out an improvement; and the noble patrician, together with all the worthy persons who with disinterested patriotism have contributed to open the gates of the castle of Odon to the studious youth, deserve for ever the applause and gratitude of those who have any regard for the true advancement of the country."

Much is attributed to the zeal, energy, intelligence, and influence of the director, Senor Don Bernardo de la Torre Rojas, of whom mention has already been made, and to the practical experience and knowledge of modern forest science of Professor Don Agustin Pascual, and *élève* of the Forst-Austalt, of Tharand.

The course of instruction soon became considerably developed and extended. Much was done by virtue of inherent energy, and powers given to the senatus and staff of professors. As extended powers were required, these were given or sanctioned by successive Royal orders. Besides those which have been referred to, there are mentioned by Senor Castel a Royal order of 2d July, 1848; one of 24th November, 1849; and one of 29th November of the same year; one of 18th January, 1850, and of 4th April of that year. By these alterations, additions and corrections were made in the regulations which were originally issued. And again, additions were made to the studies prescribed, and modifications in the arrangements for the prosecution of these, by a Royal ordinance issued 31st January, 1858.

Additional and greater changes were introduced by a Royal decree of 20th September, 1858, which greatly

modified the programme of study. On the 31st October in the following year (1859), arrangements were made for the establishment of a school of practical forestry, in which instruction might be given in forest work under the direction of a forest engineer ; and these were carried out in the institution of such a school by Royal order of the 9th December of that year, in the forest of Espinar, a village in the Province of Segovia

About the same time, in consequence of the flourishing condition of the School of Forestry at Villaviciosa, a scheme was formed for raising still higher the character of that school by increasing the number of sciences in which instruction should be given there to candidates for appointments as forest engineers, so as to make it equal to other special schools of the highest estimation in the country—if not also to the most distinguished schools of forestry in other lands. This was carried into effect in accordance with a Royal decree of 18th May, 1862 ; and at the same time the school of practical forestry at Espinar was given up, after a year's experience, under the direction of the Forest Engineer-in-Chief in charge of the service in the Province.

In no other respect was the course of study greatly changed, but this has been considered as marking the close of the first, and the commencement of the second stage in the development of the school.

In that first stage of this development very great importance was attached, and not improperly, to training in practical work in the forests. In the second stage now commenced, without detriment to such practical work, more attention than had previously been given was given to education, and instruction, and study, during the school session, and practical training was prosecuted away from the school in forest districts ; and at this time the several museums attached to the school received great additions : they then entered upon that development which has secured for them the full equipment which they have now attained

by additions obtained on the occasional and annual excursions of the students, and otherwise.

A *campo forestal*, created in 1850 in connection with a leafy wood of elms in the immediate vicinity of the school, which, with some adjacent ground, was planted with pines and beeches, and served for the practice of students in sylviculture, and the acclimisation of trees from other countries, now took more and more the form of an arboretum, or *jardine forestal*.

In the spring and autumn, to supply lack of practice in forest work, excursions were made sometimes to the pineries of the Sierra del Guadarrama; at other times to the oak and beech woods of the Liebana; also to the pineries of Coca to study the collecting and manipulation of rosin; and to the magnificent forests of Valsain and the Espinar, and to those which form the great mass of the Serranias of Cuenca and of Segura, in the province of Jaen. In these excursions the students were accompanied by some one of the professors, who, to quote from Senor Castel, 'in one place finds what suggests the explanation and discussion of matters pertaining to botanical geography, in another records of geognostic and mineralogical knowledge already acquired in the school, and always spots suitable for exercising the students in fixing forest compartments, in determining the ages of different kinds of trees, in calculating the possible yield of produce, and the many other problems which go to complete the questions embraced in the systematic arrangement of a forest.'

In the year 1866 there was published by Royal order, a report of a Tour of Observation of Forestry in the Empires of Austria and Russia, made by Royal order in the spring of 1864 by Sr. D. Maxima Laguna y Villanueva, Forest Engineer-in-Chief of the 2nd class, and Professor in the School of Forestry, *Excursion Forestal*, &c., to which reference has already been made. In this there is given the Royal order, communicated by the Minister de Fomento, under date of 30th May, 1864, requiring Senor

Lagurra to undertake the tour of observation in question, and give his attention to the state of information and mode of instruction, the administration of the forests, and the cultivation and improvement of the Steppes in the Empires of Austria and Russia.

The report treats also of the instruction given in Austria in the schools and academies of Mariabrunn, Schmitz, Weiswasser, Ausee, and Kreuz, comparing it with that given at Villaviciosa, and proposing certain useful modifications in this. It then discusses the forest services of Austria and Bohemia, Hungary and Saxony, together with the instructions in forestry given in Russia, in the School of Practical Forestry in Lissino, and in those of the Steppes, and the general administration of forests in Russia.

From 1862, the programme of study then instituted, with such modifications as have been indicated, was followed for six years. But by Royal order of 22nd July, 1868, approval was given to a new programme of entrance examination to the so-called special schools of the kingdom; and on the 23rd October of that year there was issued a decree reorganising the special schools of roads, canals and bridges, of mines and of forests. By this the number of studies required in each school was reduced, and there was substituted for instruction in these in elementary and higher mathematics, and a good many of the physical science, entrance examinations on these subjects; and on 24th October, 1870, there was issued the regulation completing what was then begun. The reformation ultimately effected, which arose out of the Acts of 23rd October, 1868, and of 24th October, 1870, is what is now in operation, modified only in one or two points by Royal order of 25th May, 1877. By the decree of 23rd October, 1868, the prescribed course embraced a period of three years; by the decree issued under date of 24th October, 1870, it was so extended as to embrace a period of four years; but by a temporary or provisional arrangement it is at present completed in three years.



The first year embraces the study of topography, geology, cubic mensuration, and applied mathematics; the second year—chemistry, mineralogy, botany, zoology, and geology; the third year—construction, silviculture, forest economy, political economy, and administrative law; and of late years a private preparatory school for students has been organised and conducted.

Students on leaving the school are attached, in the character of candidates, to forest districts; and it is only after passing through this stage of training that they receive appointments as Forest Engineers of the second class.

By His Excellency Senor Don Bernardo de la Torre Rojas, founder of the school of Forest Engineers of Villaviciosa de Odon, there was published in January, 1880, an autobiographical pamphlet entitled *Ingeniéros de Montes—Recuerdos de la Fundacion*, in the concluding note of which the author expresses his desire that it should be considered as part of his last will and testament recommending the treatise to the Forest Engineers that they should see to the preservation of it, as a family memoir, and as the last evidence he could give to them of his unchanging affection.

In the treatise itself, is declared, the philosophical sentiment adopted by him, and embodied in the institution to the effect that productive work must be founded on knowledge *saber es hacer, el que no hace unsabo*. He traces cursorally the history of the creation of the school, states certain ruling principles which served as a guide to him in what he did in founding it, and in giving to it the practical character impressed upon it; he comments on these, and enlarges on the bearing of them on the creation and maintenance of an *esprit de corps*, and the importance of this, together with self-negation, of high moral character and conduct, of discipline, and of other fundamental requirements in every professional institution designed for the service of the State,

A third stage in the development of the school commenced with the removal of it from Villaviciosa to the Escorial. Of this change Senor Castel writes:—

‘At no great distance from the Court, and in this respect not otherwise than in accordance with the text of the decree of 18th November, 1846, there was in possession of the State a valuable jewel, the bequest of the piety of our kings, and a superb manifestation of the genius of our artists. In this, among its numerous adjuncts, there were buildings abundantly spacious, and in conditions equally adequate to lodge worthily a school, though it should have to come thither from an ancient palace, the property then of the Counts of Chinchon.

‘The first building of the adjuncts to the palace, one erected for the lodgment of attendants on the Royal Court, was the building appropriated in 1869, with necessary alterations, as a site for the school which still occupies it.

‘It may be asked what were the considerations determining this arrangement? On the one hand there was the desire to save the money, which, under the head of rent for the palace school and the experiment ground, had annually to be paid to the proprietors; and, on the other, an urgent necessity existing for enlarged accommodation for the museums and cabinets, for more numerous and more valuable objects connected with the instruction given, which had been presented to the institution, than could be procured in the buildings originally assigned to them; and in fine the appropriate forestal situation of the Royal palace of San Lorenzo, and the facility which existed there for enriching the school with an experimental forest, a garden in which culture might be tried, and spacious grounds for the various forms of practice which the instruction of the students might render desirable. Without materially exceeding the distance from Madrid, and virtually diminishing this by the superior facility of communication, the new site prepared for the school fulfilled two important conditions: it gave to the school a spacious

building adequate to its requirements, and it offered to the school certain facilities for the practical study of science, in which respect the town of the Escorial compared advantageously with that of Villaviciosa, which were increased by the greater facility for communicating with Madrid. To such an extent was this the case that amongst the opinions expressed by parties best qualified to form a judgment in regard to the expediency of the removal of the school from the one place to the other, there appears an approval expressed by the founder of the School of Forestry, His Excellency Senor D. Bernardo de la Torre Rojas, who, after the removal, visiting what he always called his dear school, declared with the utmost cordiality the satisfaction which he felt in seeing it located in a situation more appropriate to the requirements of the institution.

'The alterations, rapidly executed with remarkable skill under the direction of Professor Don Ignatio Macias allowed of the transference of the school during the vacation at the end of 1870, and the consequent opening of the classes in the new premises on the 7th of January, 1871, and thus, in so much that it coincided with the decree of the 24th October in the preceding year, may be said to have completed the second period, and commenced the current period of instruction in this school.'

In the transferred school the previously existing regulations continued in force for years, being only modified by some slight alteration in the entrances and examinations made by Royal order of 25th May, 1877; and while it had been the case that there were two classes of students, one resident within the school designated *Interior*, the other being outside designated *Exterior*, but in every other respect enjoying the same advantages, privileges, and status, — this was altered, and only one class was now recognised the *Interior*, though, in consequence of the removal of the school to the Escorial, while the designation was retained all the students lived outside the school.

## CHAPTER III.

### THE SCHOOL OF FORESTRY IN THE ESCURIAL.

IN the School of Forestry in the Escorial, as was the case in the School of Forestry at Villaviciosa, for some years previous to the removal of the school to the Escorial, the curriculum of study embraces two periods—that of preparatory studies; and that of what are more strictly reckoned professional studies.

The so-called preparatory studies are classified, and are arranged in two sections, the first of which may be attested by academic certificate; the second comprises matters on which the aspirant must pass an examination at the School of Forestry. The former comprises Spanish grammar, Latin grammar, geography, and general history, with special knowledge of the history of Spain. The latter comprises arithmetic, elementary, and the higher algebra, plane and solid geometry, rectilinear and spherical trigonometry, analytical geometry of two or three dimensions, natural philosophy, chemistry, natural history, lineal, topographic, and landscape drawing, French and German.

The second period of study embraces four years spent in the school. The studies pursued during the first of these years comprise topography, integral and differential calculus, applied mathematics, applied chemistry, and drawing.

The studies of the second year comprise theoretic and applied mechanics, geology, meteorology and climatology, construction, including building and hydraulic engineering, and drawing.

In the third year are studied mineralogy and applied geology, applied zoology, applied botany, sylviculture, and drawing.

In the fourth year xilometry, or measurements of wood

of every kind ; forest *ordenacion*, or partition and exploitation on scientific principles ; forest industries ; the administration of law ; political economy ; and drawing.

This summary, however, can convey to one unacquainted with the programmes of studies followed at such schools a very inadequate conception of what is comprised under the heads stated as has been intimated.

In order to gain admittance to the school, the applicant must be accredited by certificates or diplomas of having passed an academic examination in the following subjects—Spanish grammar, Latin grammar, geography, and the general and detailed history of Spain ; and he is admitted, after passing with approval, an examination in the school on the elements of natural history, the elements of the theory of mechanics, descriptive geometry and its application to projections and to perspective, physics, chemistry, lineal, topographical, and landscape drawing, and his knowledge of the French and German languages.

The attainments made in the latter preparatory studies are determined by personal examination at the school. Every year there are issued programmes specifying the subjects on which applicants for admission must be prepared to be examined. According to the programme for the year 1877, the only one I happen to have at command, the preliminary entrance examination through which applicants have to pass embrace amongst others the following subjects:—Theory of mechanics, the general principles of statics, and their application to the determination of the centre of gravity ; the general principles of dynamics, including inertia, momentum, reaction, vital force, movements of points and movements of bodies under varied conditions, and the establishment of equilibrium. Descriptive geometry : its application to projections and perspective, embracing points, straight lines, circles, and planes, triangles, polyhedrons, sections and intersections of these, tangents, cylinders, cones, lines of revolution, involution, plane and conic sections, the projection of

shadows, and the geometrical laws of perspective. **Physics** : properties of bodies; gravity, specific gravity peculiarities of solids, of liquids, capillarity, gases, atmospheric pressure, elastic force of bodies, flotation, and temperature. **Acoustics** : propagation of sound, and distinctive character of sounds. **Heat** : expansion of bodies in a solid, a liquid, and a gaseous state, and operations by which it is effected ; hygrometry, and transmission of heat. **Optics** : propagation of light, photometry, reflection from plane and curved surfaces, refraction and dispersion of rays, structure of the eye, optical instruments, double refraction, and polarization of light. **Electricity and magnetism** : static electricity, distribution by conductors, measure of electric force, magnetism, dynamic electricity, electro-magnetism, electro-telegraphy, thermo-electric currents, electric induction. **Meteorology** : thermometrical observations, winds, aqueous phenomena, electric phenomena, luminous phenomena. **Chemistry** : chemical notation, combining proportions, theory of chemical equivalents, specific heat, atomic theory, metalloids, and their more important compounds, other elementary bodies, the more important combinations of hydrogen, combinations of oxygen with other quasi-elements, fluorate of silica, carburetted hydrogen, cyanogen, general properties of metallic and other salts, special study of the more important metals and their compounds. **Natural history** : distribution of existing bodies in groups and kingdoms, distinctive characteristics of species, of organs, apparatus and functions, mode of studying minerals and determining their production, composition, and importance, crystallography ; classification, nomenclature, and chemical properties of minerals. **Botany** : structure and forms of vegetables, organs of vegetation, roots, stems, leaves, with their variation and arrangement, and effects of this on ramification ; flowers, inflorescence, calyx, corolla, stamens, pistils, and ovary ; fruits, seeds, vegetable physiology, nourishment and growth, reproduction, classification, and specification of properties common to classes of plants. **Zoology** ; difference between animals and vegetables,

animal structure, organography, and physiology; classification proposed by Cuvier and modified by Milne Edwards; characteristics of mammiferae, with description of the principal families of rodents, of pachydermata, and of ruminants; characteristics of birds, and description of the principal families of gallinaceous, of wading and of web-footed birds; characteristics of fishes, and description of the principal families of soft-finned fishes; characteristics of the principal families and the more remarkable genera of the coleoptera, of the orthoptera, hymenoptera, and lepidoptera; and the geographical distribution of animals, with causes influencing this.

On such subjects the candidate for admission is examined before he can enter the school. He is free to pass through these preliminary studies when and where he pleases; and there are specified works on the several subjects from which information preparatory to examination may be obtained.

It is stated that in the examination in drawing there will be required manifest facility in copying correctly an order of architecture, or a machine; some model drawing of a landscape in *Les Etuds d'après Nature*, by Calamé, and a pen-and-ink representation of mountains, sands, rocks, and arable land, according to the method of Rindavets; and in French and German, correct translations from these languages into Spanish.

Application for admission must be made previously to the 1st of September in any year.

It is not requisite that the applicant should be examined in any one year on all of the subjects embraced in the entrance examination, and he is required to specify those on which he desires to be examined. If he pass any examination with approval, this will be certified, and when he has been examined in all with approval he will be admitted, and enter on the special studies of the school.

After admission the first year's course of study, as has

been stated, comprises among other subjects, topography, applied mathematics, and applied chemistry.

The programme of studies under the head of Topography comprises 1. The determination of the object of topography and the difference between this and Geodesy. 2. General rules in regard to triangulation, and methods of giving a graphic representation of the ground. 3. The selection of a system which should be followed, and methods which should be employed according to the cases in the preparation of a chart or plan; and methods to be adopted in the case of lands covered with woods. 4. A theoretic and practical knowledge of the instruments and apparatus employed to obtain the data required; and of instruments more adequate to meet the necessities of forestal topography. 5. Calculations to be made with the data obtained. 6. The constructions of plans; horizontal projections; and scales. 7. The resolution of partial problems, such as tracing lines of the same altitude or level; valuation or determination of areas and volumes; the division of superficies, and the finding or training of proper divisions in the forests, in order to the separation of quarters, sections of the forest for successive operations, and limits of fellings.

With regard to Applied Chemistry, it may be remarked that amongst the preparatory studies, a satisfactory knowledge of which is required as a preliminary to admission into the School of Forestry is the general science of chemistry. In the school studies, under the head of applied chemistry, is comprised the study of the objects and the divisions of analitic chemistry, including: 1. With regard to a laboratory, the instruments and apparatus which it should contain, and the use and manipulation of these. 2. Reactions and general chemical analysis. 3. Quantative analysis, and the volumetric method of procedure. 4. Qualitive and quantitative analysis of rocks. 5. Analysis of earths in general, and in particular that of those which constitute the soli of the forests. 6. Different methods of



reducing plants to ashes, with a special regard to that of lignous plants, and the qualitative and quantitative determination of the fixed elements in the same. 7. General analysis of the waters and the elemental constituents of organic substances. 8 Application of chemistry to vegetable physiology and to sylviculture, to the preservation of wood, and to the carbonization of wood, and the determination of its calorific potency. 9. Dosification or determination of quantity of tannin in materials containing this.

In the cabinet and laboratory of chemistry provided for the instruction of the students in chemistry, there is in the school an extensive and well-equipped laboratory, with various furnaces, water-pipes, and four tables covered with zinc. Crucibles, capsules, retorts, mortars, retort stands, lamps of different kinds, and other accessory utensils are there in no stinted numbers; and pneumatic troughs, water and mercurial glass jars of different sizes, permit of the collecting and study of gases.

A varied collection of reactives to facilitate analytical experiments are contained in a case of great value, together with the more indispensable apparatus, which, in virtue of its small volume, is contained in the chest of Platner, made with admirable perfection.

Amongst other articles and apparatus deserving of special notice may be mentioned eudiometers of Volta and of Hitscherlich; different delicate balances; the apparatus of Donovan for filtration without access of air; that of Marguerite for the dosification of oxygen; that of Guy-Lussac for the analysis of potash; that of Pelouze for the analysis of copper; that of Mohr for the extraction of ether; the sulphi-hydrometer of Dupasquier; the saccabrometer of Mitscherlich; the apparatus of Bunsen and Bischoff for spectral analysis; and various others not less important for the analysis of earths, of chlorine, of lead, and of other bodies.

Amongst the material pertaining to analytical chemistry the school possesses the elements necessary for volumetric

analysis, by means of specified liquids and for the qualitative and quantitative analysis of organic substances.

In the studies of the second year are comprised those of applied mechanics; geodesy or land surveying; meteorology and climatology and construction, under which are comprised works of hydraulic engineering and forest buildings.

The programme of study in Applied Mechanics comprises:—1. The general ideas and principles and general laws of forces and motion. 2. General observations on machines, and the study of their essential organs. 3. Changes of motion of most frequent application in machines, moderators and regulators, passive resistances. 4. Transport in general; forestal transports. 5. General principles of hydrology water gauge of natural and artificial currents; the distribution of waters; modules or appliances for securing uniformity of delivery; and partidors for securing the same in dividing currents; units of measurement in the gauging of waters. 6. Calculation of resistances, thickness of dykes of conducting pipes and of steam boilers. 7. Motors: hydraulic motors, steam motors, wind motors. 8. Machines employed for raising liquids, machines employed to transmit gases. 9. Forestal tools and instruments: hammers, machines, mills, cutting tools, and saws.

In the Cabinet of Mechanics there are various levers and balances; pulleys, single and combined, and in blocks; models of simple and differential wheels, and wheels with a catch; capstans; cylindrical and conical accumulators; cog-wheels; elevator; fixed crane, and moveable crane; inclined plane, wedge, shears, circular eccentric; expanding eccentric; spiral of transformation; vertical and circular saw; Atwood's and Morin's machines; apparatus to demonstrate the parabolical movement in the fall of solids and liquids; pendulums, simple & Kater's; endosmometer of Dicrochet; Venturi's apparatus; apparatus of

capillary tubes, that of Bohnénberger; syphons, ordinary double syphon, and that of Porta; float of De Prony; funnels, gasometer, spherical float, hydrometric pendule, tube of Pilot, rheometers of flat paddles, and of Polellu; Woltman's mill; different parts of pumps; pistons and valves of different kinds; suction pumps, forcing pumps, suction and forcing, and combined rotary pumps of different kinds; water-wheels with cords, and with chain pumps and buckets; archimedian screw; drum; hydraulic ram; water-wheels with flat floats, with boxes, with buckets, and that of Poncelet; turbines of Fourneyron, and of Koechlin; wind mills; distributors fixed, and oscillating cylindrical; Leroy's spring dynamometer; steam engines, different models; Krampton's locomotive.

The programme of study, under the head of Geodesy, comprises:—1. The determination of the object of geodesy or land surveying. 2. The necessity of a network of triangles, in order to the determination of the distance of given points on the ground, and the projection of these on the area of the ground. 3. Stations and signals; a general idea of the superficial figure of the ground; geographical maps; a knowledge of the geodesic instruments required in the calculations of the angles of the triangles, different modes of procedure, and causes of error which it is necessary to avoid or to correct in each case. 4. A base line and apparatus for the measurement of it; the connection of this, the base, with the triangles of the network, and calculation of the sides of each triangle. 5. Determination of the longitudes and latitudes of the vertices and azimuths of the sides of the triangles, and the distance of the meridian and its perpendicular. 6. Geodesic determination of altitudes; and barometric levelling, or determination of altitude by barometric observation. 7. Necessity of triangulations of the second order; difference between this and the first in respect to operations and calculations; convenience of triangulation of the third order, in order that a connection may thus be

obtained between the operations of geodesy and those of topography. 8. Construction of geographic maps.

For instruction in topography and geodesy, and for use in practical exercises in both departments, the school contains, writes Signor Castel, abundant material, acquired for the greater part with funds supplied by the State. Grouping the articles with a view to a brief description of them, they may be classed together in the following order:—

*Apparatus for use in the direct measurements of distance.*—

Chains, tape measures, similar measures made of elastic steel, levels, and graduated rulers.

*Apparatus for use in the indirect measurement of distances.*—

A Lugeol micrometer, Ertel's telemeter, longimeter, eye-glasses of the tachometer, and of the olometric theodolite of Porro: mobile estadias; Groetar's apparatus.

*Angle-determining instruments.*—

Quadrants, pantometers, grafometers, box compass, Burnier's compass, level with vertical arc, Ladois' level, Linglaé's level; sight, with reflection by Porro; Kater's compass, Cugnot's planchette or circumferenter, French planchette, German planchette of Lehman, planchette perfected by Ertel and Starke; quadrant with sights, with eye-glass, with eye-glass and level, with an arc of a circle; declinator used in dialling, copper compass, reflecting mirror, quadrant with two eye-glasses; graphic sextant, another with two eye-glasses, pocket sextant; Porro's sextant, reflecting by prisms with water-level; the same, with sights and one eye-glass; Porro's octant of reflection and graphic prism; Douglas's circle of reflection; artificial horizon; theodolites on system of Richer. Spanish theodolite, German theodolite of Breithaupt, theodolites of Troughton, Pastorelly, Evererest; Troughton's repeater; Brunner's theodolite of the third order, Brunner's of the second order; Troughton's great zenithal circle; Gaus's heliotrope.

*Instruments used in levelling.*—

Mason's level, water level, level with prism and perpendicular, clisimetres of Burel and of Mayer, levels of Chairgrassc, levels with sights,

level of mercury and eyeglass, Porro's simple level, Porro's level with compass, simple level with eye-glass, levels of Ertel, of Grairats, of Casella, and of Lincke with eye-glass, eclimetric level of Chezy, great level of Dollon ; *miras*, or sight knobs of different kinds.

*Instruments used in constructing Plans.*—Case of large mathematical instruments ; pocket case of instruments ; graduated scales of wood, white metal, and platinum ; rulers and squares, graduated squares, compasses ; semi-circular transportador, with scale ; another with scale and nonius, one with entire circle and nonius, that of Troughton with two nonii ; pantograph.

*Determination of areas.*—Planimeters of Elliot, and of Beuviere and Starcke.

*Various instruments.*—Eye-glass of prism, of Porro, of observation and delineation ; astronomic telescope, spherometer, Focometer, chronometer, D. Carlos Ibannez's apparatus for measuring bases ; rule, stands, microscopes, levels, eye-glass for delineation, eye-glass for references, tracer, &c.

The programme of study in meteorology and climatology comprises—1. The study of the atmosphere, and its principle properties. 2. The nature and laws of light, heat, magnetism, and electricity, and phenomena presented by each of these agents. 3. Winds : their origin, laws, and different characters which they present. 4. Aqueous meteors, and theories and hypotheses advanced in explanation of them. 5. Theoretic and experimental study of apparatus used to measure the intensity of meteorological phenomena. 6. Connection and dependence of some meteors on others. 7. Climates : factors which determine the origin and classification of different climates. 8. Action of the atmospheric agents and of meteorological phenomena on the life of plants. 9. Relations between the factors of climate and the orography, nature, and vegetation of an extensive district.

The Cabinet of Meteorological apparatus and a Méteorological observatory contain an anemometer by M. Osler ;

and another, that of Dr Robinson; a barometer of Newman, a large specimen; a well barometer, of the English pattern, with the scale in inches; two of Fortin's barometers; a barometer of Gay-Lussac; an aneroid barometer; a barometer of M. Bourdon; a hygrometer of Regnault, a hygrometer of Daniel; an English pycrometer, by M. Casella, on Masson's system; ordinary thermometers; also maxima and minima thermometers; also that of Walferdin, &c.; and a pluviometer.

Of the arrangements made at the Escuria to facilitate the study of forest science, that which proved most interesting to me was the observatory, partly because of the importance of the objects which it was designed to subserve, partly because of the knowledge I have of work done by students in the prosecution of researches connected with them after they have left the school; and partly because of the simplicity and inexpensive character of the arrangements made.

The meteorological observatory is in the *campo forestale* of the school. It is a building of less than twenty feet square, and of similar height. On the flat stone roof of it are arranged the instruments employed. To them all the students have access at any time. Of these, from time to time, two are appointed to make and record observations.

The observations made by the students are published every fortnight in the *Revista de Montes*, in a tabulated form. In this are stated in regard to every day the height of the barometer at 9 A.M. and at 3 P.M., the average or medium height of these, and the variation found by subtracting from the greatest height at 3 P.M. the lowest at 9 A.M.; the maximum and minimum temperature; the variation and the medium temperature of the ground; the relative humidity at the same hours; the rainfall; the direction and the force of the wind; and observations in regard to the clouds in connection with the state of the winds.

The studies comprised under the head of Constructions

are—1. The general conditions of a good construction, and the materials employed, including an examination of the qualities, extraction, preparation, and fabrication of these materials. 2. Foundations, and operations relative to the establishment of these in different cases; sinking wells; raising piers. 3. Construction of walls, partitions, and roofs. 4. Stables, sheds, bridges. 5. Hydraulic works: tracing and locating confining walls and dykes; arrangement and construction of leading canals, and of canals of derivation. 6. Application of principles of construction to seed-drying stores, and stores of timber and firewood, pitch kilns, and saw-pits or saw-mills. 7. Road-making: highways, forest wood tracks, and forest bridges.

In the studies of the third year are comprised—Mineralogy and Applied Geology, Applied Botany, Applied Zoology, and Sylviculture.

The programme of study in Applied Geology comprises—1. Definitions and divisions of geology, and specifications of its relations to the other sciences, and especially to sylviculture. 2. General geography, which treats of mountains, and in particular the geography of Spain. 3. Physical geography. 4. Petrography, or natural history of rocks and stones; origin of rocks, their characteristics and analytical decomposition. 5. Natural decomposition of rocks, nature and forestal conditions of the land thus produced. 6. Geologic periods, natural history of stratification. 7. Description of the different geognostic formations which constitute the terrestrial crust, and their forestal applications. 8. General notions of palæontology, and description of the principal fossils characteristic of each formation.

Instruction in what is designated Applied Mineralogy comprises—1. Fundamental ideas, and the characters and chemical and physical properties of minerals. 2. Chrystallography, systematic mineralogy, different classifications of minerals. 3. Analysis of minerals. 4. Description of the more important kinds of minerals, with special attention

given to those which enter into the composition of the rocks and the soil found in forests.

For use in the study of geologic mineralogy the school possesses two collections: one chrystalographic, the other mineralogical.

The chrystalographic collection is composed of 336 models in plaster of Paris, formed and arranged according to the system of Naumann, and containing in each chrystaline system representatives of its typical holoédric and hemiédric forms, and of the more remarkable combinations of one form with another, &c.

Double crystals, or hemitropes and anomolous and imperfect forms: there are in this collection crystals and models representative of the fundamental forms of the recognised systems of these, and of their primary derivation.

The mineralogical collection contains 770 specimens, each of which is representative of a type, a variety, or a different locality. It comprises 175 distinct species, amongst which are representatives of the 15 classes of Naumann, on whose system they are arranged; there being largely represented the classes - 1, metallic oxides; 3, haloids; 5, geolites; and 6, anfoterolites; these being considered the most important for study in the career of a forest engineer.

And for instruction in geology this museum contains, as important auxiliaries, a petrographic, and also a palæontological collection.

The former is composed of 800 specimens of rock, of which the greater number are Spanish, and some are French, representing the most varied types and varieties of the principal species found in the Peninsula.

The collection of fossils consists of 1200 specimens, classified according to different characters of ground, after the method of d'Orbigny, and bringing together types of the most characteristic species of all of these. The total number of species represented is about a thousand.



Under the head of Applied Botany, or botany in its connection with the studies and subsequent work of the forester, there are included in the prescribed programme of the class—1. Definitions and general ideas in regard to organised bodies. 2. Characteristics of plants or vegetables, organography and morphology. 3. Anatomy, physiology, and nosology of plants. 4. Methodology, classification in general, artificial systems of classification. 5. Natural classification. 6. General description of the principal families of plants, with a special and detailed description of the woody plants of the flora of Spain. 7. Geographical botanical association of vegetables, affinities and analogies determining their distribution. 8. Agents influencing the distribution of plants. 9. Distribution of trees and shrubs in the forests of Spain.

In the Cabinet of Botany, in the museum, there were contained, according to Senor Castel in 1877, the herbarium of the Senores Boutelou, presented to the school by Dona Maria Soldevilla de Boutelou, in the year 1848. In this herbarium there are 9244 species of plants from different countries, a great proportion of them being from America; another European herbarium of 3000 species, the greater part of them being French, but the collection being increased from day to day, chiefly by the addition of Spanish plants; and a herbarium of 500 species of Spanish lignous plants prepared by the 'Comision de la Flora Foresta';\* a herbarium composed of plants found in the vicinity of the Escorial, in which are more than 800 species of phanerogams; a collection of 120 species of ferns from the Phillipines, presented by the Ilmo Senor D. Isidro Sainz de Baranda; various collections prepared by Professor Rabenhorst, comprising in all 5030 species of cryptogams, distributed into the following groups: vascular

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\* Amongst works illustrative of the natural history of forest trees and other plants, a prominent place must be assigned to the works prepared by the 'Comision de la Flora Foresta,' by which was presented to the museum of the school this herbarium of 500 species of lignous plants. Of this, descriptive of the collection of specimens, and of similar works from the Phillipines, an account will afterwards be given. These are made mention of here as supplying facilities for the study of the specimens exhibited.

cryptogams, 120; mosses, 1200; liverworts, 550; lichens, 900; algae, 2260; a collection of transverse sections for the anatomical study of wood of different trees, presented by Professor Nordlinger, consisting of 500 species belonging to different regions of the globe; a microscope by Oberhauser, with two lenses.

The collection I found considerably enlarged beyond what it was at the time Signor Castel prepared this account of it; but I did not enquire to what extent the specimens preserved in it had been increased in number.

Besides this museum, there are within reach, and of easy access, the trees growing in the botanic garden in Madrid, and those growing in the gardens attached to the institution at the Escorial.

In 1877, the latest year in regard to which I have at command any reports, there were growing in the gardens attached to the school specimens of the following trees:—

*Abies balsamea*. Mill, *Abies excelsa*. D. C., *Abies Morinda*. R., *Abies Nordmanniana*. Spach., *Abies pectinata*. D. C., *Abies pinsapo*. Boiss., *Acer monspessulanum*. L., *Æsculus hippocastanum*. L., *Androsæmum officinale*. All., *Araucaria imbricata*. Pav., *Arbutus unedo*. L., *Arbutus uva-ursi*. L., *Aucuba japonica*. L., *Berberis vulgaris*. L., *Bupleurum fruticosum*. L., *Buxus balearica*. Lam., *Buxus sempervirens*. L., *Buxus sempervirens*, var. *aurea*. L., *Castanea vesca*. Gaertn., *Catalpa bignonioides*. Walt., *Cedrus atlantica*. Manett., *Cedrus Deodara*. Loud., *Cedrus Libani*. Barrel., *Celtis australis*. L., *Cephalotaxus pedunculatus*. Sieb., *Cerasus Lauro-Cerasus*. Lois., *Cerasus lusitanica*. Mill., *Cercis siliquastrum*. L., *Cissus quinquefolia*. Desf., *Cistus salviæfolius*. L., *Clematis vitalba*. L., *Cornus sanguinea*. L., *Coronilla glauca*. L., *Cratægus monogyna*, Jacq., *Cupressus fastigiata*. D.C., *Cupressus glauca*. Lamk., *Cupressus horizontalis*. Mill., *Cupressus pendula*. Staunt., *Cydonia japonica*. Pers., *Cytissus Laburnum*. L., *Deutzia crenata*. Sieb., *Deutzia gracilis*. Zucc-Erica scoparia., L., *Eriobotrya japonica* Lindl., *Eucalyptus globulus*. Labill., *Evonymus japonicus*. L., *Evonymus japonicus* var. *argentea*.

L., *Evonymus japonicus* var. *aurea*. L., *Forsythia viridissima*. Lindl., *Frangula vulgaris*. Reichb., *Genista florida*. L., *Gynerium argenteum*. Nees., *Hibiscus siriacus*. L., *Ilex aquifolium*. L., *Jasminum fruticans*. L., *Jasmin. nudiflorum*. Lindl., *Jasminum officinale*. L., *Juglans regia*. L., *Juniperus oxycedrus*. L., *Juniperus virginiana*. L., *Lavandula spica*. L., *Ligustrum japonicum* Thunb., *Ligustrum vulgare*. L., *Ligustrum vulgare*. L., *Ligustrum fol. variegatis*. L., *Lonicera hispanica*. B. et R., *Magnolia grandiflora*. L., *Mahonia æquifolium*, Nutt., *Mahonia Fortunei*. Hort., *Morus alba*. L., *Myrtus communis*. L., *Nerium oleander*. L., *Paliurus australis*. Gaertn., *Paulownia imperialis*. Sieb., *Philadelphus coronarius*. L., *Phlomis fruticosa*, L., *Photinia serrulata*. Lindl., *Pinus Austriaca*. Tratt., *Pinus halepensis*. Mill, *Pinus insignis* Dougl., *Pinus laricio*. Poir., *Pinus pinaster*. Sol., *Pinus pinea*. L., *Pinus pinea*. var. *fragilis*. Lois., *Pinus sabiniana*. Dongl., *Pinus Strobus*. L., *Pinus sylvestris*, L., *Pittesporum chinense*. Don., *Platanus vulgaris*. Spach., *Populus alba*. L., *Populus balsamifera*, L., *Populus canadensis*. Mich., *Punicagranatum*. L., *Punica granatum flore pleno*. L., *Quercus suber*. L., *Rhamnus Alaternus*. L., *Rhus thyphina*. L., *Robinia pseudo-acacia*. L., *Rosa bengalensis*. Hort., *Rosa centifolia*. L., *Rosa Damascena*, Mill, *Rosmarinus officinalis*, L., *Ruscus aculeatus*. L., *Salix babylonica*. L., *Sarothamnus purgans* G et G., *Sequoia gigantea*. Endl., *Spartium Junceum*. L., *Syringa persica*. L., *Syringa vulgaris*. L., *Thuja orientalis*. L., *Thuja gigantea*. Dougl., *Ulmus campestris*. L., *Viburnum opulus*. L., *Viburnum tinus*. L., *Weigelia rosea*. Lindl.

Besides these, there had been planted during the years 1871-1876, while it was in connection with the school park of the Casita de Arriba, in the vicinity of the Escorial, specimens of the following species of trees :—

*Abies pectinata*. D. C., *Abies pinsapo*. Boiss., *Acer pseudoplatanus*. L., *Argania Sideroxylan*. Roem. et Sch. *Æsculus hippocastanum*. L., *Castanea vesca*. Gaertn., *Celtis australis*. L., *Cupresus fastigiata*. D. C., *Cupr. glauca*.

Lamk., *Cupr. horizontalis*. Mill., *Cytisus Laburnum*. L., *Eucaliptus globulus*. Lauill., *Fagus sylvatica*. L., *Fraxinus oxyphylla*. Bieb., *Gleditschia triacanthos*, *Juglans regia*. L., *Juniperus oxycedrus*. L., *Paliurus australi*. Gaertn., *P. canariensis*. Buch., *P. laricio*. Poir., *P. pinaster* Sol., *Pinus pinea*. L., *P. sylvestris*. L., *Robinia pseudo-acacia*. L., *Quercus ilex*. L., *Q. robur*. L.—*V. pedunculata*, *Q. robur*. L.—*V. Sexiliflora*, *Q. snber*. L., *Q. toza*. G., *Thuya orientalis*. L., *Ulmus campestris*. L.

In the capital, moreover, there is the valuable Botanic Garden, to which there is free access for all, and in where there are not only umbrageous walks, lined with trees labelled with their popular scientific names, but numerous trees so labelled growing freely in the enclosed spaces. It was removed from a situation on the road leading from the palace to the Prado to its present position, by desire of Carlos III., and it abounds in the products of foreign climes.

In the first year of the present century M. J. F. Bourgoing, who had been Minister Plenipotentiary from France to the Court of Madrid, wrote thus of the foundation of the present fame of this garden: 'At the commencement of his administration of the Indies Galvez earnestly recommended to all officers—civil, military, and ecclesiastical—within the whole circuit of the colonies, to transmit to Spain whatever appeared worthy of notice in the three kingdoms of nature. His directions were complied with, at least with respect to the vegetable kingdom. Scarcely a year elapses without announcing the arrival from the Spanish Indies of some new plants, which augment the collection of the metropolis, or at least the importation of seed, of roots, and slips, which they endeavour to naturalise in the Botanical Garden at Madrid. Young botanists, whom the Court maintain in Mexico, Peru, and elsewhere, transmit along with their consignments a description of the plants immediately within their observation, and of the soil and atmosphere which appear most congenial with them, and of the culture

they require. Conformably with these instructions the professors of botany deposit the germs transmitted to them in the earth; and attended by their disciples they watch with the most wistful solitude their different appearances during growth, in order to compare the properties of these exotic plants with the description that has been sent to them.

Such are some of the provisions made for the study of applied botany.

Mineralogy, geology, and zoology, with much besides, are all included in the Natural History in which the aspirant is examined before being admitted into the school; but there the prosecution of the study of each is continued. Under the head of Applied Zoology is comprised:—1. A statement of difference between the general zoology and that of zoology pertaining to the department of forests; observations on the organography and physiology of animals; and on organic harmonies, analogies, and homologies. 2. The classification of animals and nomenclature adopted; general theory of classifications. 3. General study of the vertebrates, with a description of the indigenous species useful or damaging to the forests. 4. Forestal entomology; the importance of the study of insects with an application to the department of forests; a description of all the species useful and detrimental to sylviculture; study of preventive and destructive measures employed against those which are detrimental. 5. Geographical zoology, giving an idea of the distribution in the Peninsula of those animals to which pertains a forestal interest.

For the study of Applied Zoology there are in the cabinet of zoology the following collections:—

A collection of forty-five species of mamifers, in which there are, or were in 1877, when Senor Castel prepared the statement, comprised ninety-two specimens, amongst which predominate the insectivora, carnivora, rodentia, pachydermata, and ruminantia, being the groups most impor-

tant in silviculture, and amongst these are specimens of all the species found in the forests of Spain.

Another is composed of 103 species of birds, of which there are 141 specimens; the most numerous being the raptores and the passeres. Another of 37 species of reptiles and bactrians, and some river fishes.

A collection of 1641 specimens of insects, distributed under 522 genera and 1000 species, comprising a great part of the foreign as well as indigenous species useful and hurtful to forests. 25 picture-frames contain woods attacked by insects; in each of these is a specimen of the wood, with the damage done, and the insects by which it is attacked.

A collection of nine anatomical frames represent in wax figures, on a large scale, the digestive apparatus of certain insects, the ovaries and spawn of the lobster, and the nervous system of the cephalopods, prepared by D. Jacinto Castro, the naturalist preparer of the school.

There are also two collections of shells, composed one of 102 species, and the other of 196 species, consisting of 400 specimens, the latter prepared by Senor D. Luis Urrejola, an engineer-in-chief of the corps. Besides these, there are sundry small collections for use by the professors and in the practical studies of the alumni.

The programme of Silviculture studied in this the third year of the course, comprises:—1. The natural history, &c., of different species of trees cultivated. 2. Extent of successive fellings, and duration of cycle or period embraced between sowing and clearing of successive crops; and methods of exploitation: timber forests, coppice woods, and mixed forests. 3. Methods of felling, and theory of clearings. 4. Sowing, gathering, and preservation of seeds. 5. Preparation of the ground for sowings. 6. Season, and method most to be preferred in different cases. 7. Plantations, perches, and poles. 8. Cultivation of wood, and of drift sands. 9. Reboisement and creation of turf on mountains. 10. Pastures and protection against trespasses.

In the cabinet of sylviculture, writes Senor Castel, for a practical acquaintance with the implements of labour employed in sylviculture, not only in Spain but also in the principal agrico-forestal centres abroad, there is located in the school a magnificent collection of 400 specimens of these, of perfect construction, and arranged with great taste. They comprise implements used in turning over earth, such as spades, hoes, pickaxes, two-pronged forks, rakes, weed-hooks, &c.; together with these are those used in the surveying and treatment of trees, among which the most important are axes and saws of a great many different forms.\*

There are also an abundance of mattocks, knives, adzes, hooks, mallets, hammers, rammers, gouges, augurs, gimlets, scrapers, shears, &c., &c.; and there are not wanting those modest aids in sylviculture—sowers, planters, transplanters, pruners, &c. Fruit gatherers, tree ladders, resin collectors, scrapers, resin tree openers, hooks for use in rafts of wood, timber, scythes, &c., complete the collection, which, when shown at some exhibitions, has had awarded to it the highest distinction granted for this class of objects.

This cabinet contains also a collection of 60 ploughs, harrows, rollers, levellers, rakes, scythes, axes, mattocks, two-pronged forks, and sowing machines, perfectly executed on the scale of  $\frac{1}{4}$ th and  $\frac{1}{8}$ th of full size.

In the studies of the fourth year are comprised xilometry; forest *ordenacion* and exploitation; forest industries; political economy and administration of law; while drawing is practised continuous from the commencement of the curriculum till its close.

\* Among the axes in this cabinet there deserve special notice the pruning hand-axe used in Arragon; the French hand-axe; the common axe with one cutting edge, *hoca*; the common hatchet with long handle; axe used in cutting for resin in Coen; small pitch-maker's hatchet for cutting pitch-wood; hatchet for splitting wood; French hatchet for testing; pitch-maker's axe with shield; pitch-maker's hatchet without shield, for use on foot; testing hatchet with two edges, used in Cuenca; testing hatchet used in Jaen; pointed axe used in charcoal making in Cuenca; common wood-cutter's axe; American testing axe; workman's axe used in Segovia; testing and felling axe used in Jaen, called the Biscayan axe; axe of Dabie; axe of Chaubray; axe of Macon, called *Taillemare*; Leipzig axe; fireman's pointed axe; marking hatchet used in forestal districts; English woodman's axe, &c.

The programme of studies in Xilometry comprise :—1. A discussion of the general forms affected by the different parts of a tree; the geometric and dendometric volumes of these. 2. Description of dendometric instruments, and the management and comparison of these. 3. The determination of the cubic contents of trees considered isolated or individually. 4. The apparent, and the real volume of wood; xilometers: description, comparison, and use of them. 5. The determination of the normal co-efficient. 6. Methods of determining the value in respect of the weight and density of the timber. 7. Increase of wood in growth, and determination of future and of maximum increase. 8. The branding or marking of timber.

In the cabinet of xilometry are various compasses for the determination of diameters in the trunks of trees; tape measures, and other metrical cinctures; rules for marking of timber fit for cutting; ordinary circumference meters; circumference meters of Bouvart; dendrometer by right angled triangles; dendrometers by arc of a circle; dendrometers by the square or the perpendicular.

In connection with the study of the *ordenacion* of forests for successive thinnings and fellings, or the partition and arrangement of sections, attention is given to—1. Definitions of terms in use in *Dasonomia*, or forest science, a term derived from *Daso* forest, and *Nomos* law. The object of *dasocracia* and divisions of the subject. 2. The legal and natural condition of the forest. 3. Forestal condition; *dasometry*, forest measurement; and *dasography*, or preparation forest maps. 4. Forestal condition, determination and survey of partitions designed for fellings, and *epidometry*, or measurement of the trees. 5. Selection of kinds of trees to be felled, and of treatment to be adopted; that of coppice-wood or timber forest, and duration of cycle of operations. 6. Methods of exploitation; exposition of that devised by J. L. Hartig and by E. Cotta. 7. Rational or scientific methods. 8. General plan of exploitation. 9. Special plan of operations in the first



period. 10. Determination of the maximum possible production; reserves, and successive revision of scheme of exploitation. 11. Systematic management of irregular forests. 12. Valuation of forests, interest, dues, profits. 13. Value of the soil. 14. Value of the vegetable covering of the ground. 15. Value of the forest.

The programme of studies under the head of forest industries embraces:—1. The physical properties of different kinds of woods, and deductions from these relative to principal applications which may be made of them in civil and naval architecture. 2. The exploitation of primary and secondary products of forests; and the transport of these by land and water. 3. Storage, and storage charges of wood; its conservation by means of substances injected into it; and the preparation of wood pulp. 4. The collection of resin, and preparation of products derived from resin. 5. The preparation of charcoal, charcoal fuel, and potash. 6. Barking of trees, the disposal of bark, and the manufacture of cork. 7. Collection and preservation of seeds for employment in manufactures. 8. Manufacture of oils, essences, and acids from forest seeds. 9. Pannage and swine herding, and disposal of prunings. 10. Utilisation of dead wood, branches, leaves, and peat.

In one section of the Cabinet of Forest Industry, confined to objects from Spain, there is a collection of models representing a secherie for drying seeds; fanners for dislodging fine seeds; vertical and horizontal furnaces used in Sweden in the fabrication of vegetable carbon; three carts for transport; and *pequiras*, or piles of pine wood burnt to make pitch, from Sierra Segura; tools used in disbarking the cork oak, and in the manufacture of corks; and the more important implements used in the collecting of resin; various collections of wood arranged in boards of different sizes, comprising specimens from the different provinces of Spain; and a collection of 200 species of these woods, the produce of indigenous plants, arranged according to the method of Rossmoessler; collec-

tions of charcoals and potashes, ashes, barks, resins, gums, corks, esparto grass, and palms.

In a second section, containing colonial products, are preserved products of the Island of Cuba—a forestal collection presented to the school by D. Francisco de Paula, a member of the corps of forest engineers—composed of 36 cases, each containing leaves, branches, a board specimen of the trunk, charcoal, firewood, bark, and any other product of the plant to which it is dedicated, and a collection of woods comprising 200 specimens. Of products of Porto Rico there are two collections of woods in boards, and composed of 200 specimens of forest trees produced in that island, and another collection of woods in blocks from the same locality. Of products of the Philippine Islands there are a collection of woods consisting of 90 species, comprising the principal kinds growing in the Archeipelago, and a collection of textile materials, and articles fabricated of forestal products of the Philippine Islands.

The programme of study in the administration of justice comprises:—1. Fundamental principles in regard to the State, the Government, and the Administration; and the character and range of the administrative organisation of the country. 2. The administrative organisation of the country, and territorial limitations of the authorities, of the functionaries, and of corporations in active administration, in consultation, and in settlement of disputes. 3. Duties and legal position of public employes in general; legislation in regard to administrative matters of general application, such as those relative to undertaking public service, responsibility, &c. 4. General idea of ancient legislation in the branch relating to forests. 5. Special legislation relative to the facultative or professional, and the administrative service in the public forests; forest exploitations, delimitations, watching, fires, &c. 6. Transfer of property; acquisition of forests by the state; excambis; ex-appropriation. 7. Police of the State forests; penal portion of the ordinances; forests belonging to private proprietors,

The study in Political Economy comprises:—1. Definitions and general idea of the science. 2. Production and capital, and natural differences observable in capital. 3. Natural agents concurring in production. 4. The study of labour; of the general conception of this, and of advantages and disadvantages resulting from division of labour. 5. Idea of value in things; prices; interest. 6. Influence of the quality and quantity of the production on the increase or diminution of population. 7. Consumption of products.

Drawing is practised from the commencement to the close of the professional curriculum. The instruction in this pertaining to what may be required in the work to which the students aspire, comprises:—1. Topographic drawing; the representation of lands, according to the generally accepted principles of procedure; hand-drawings, washed with China ink, or with an application of colours and conventional tints. 2. Drawings of machinery, and elevations of buildings. 3. Phytographic drawings, or representations of species of vegetables. 4. Dasographic drawings, comprising plans or charts; phytographic, geognostic, forest partitions, &c., &c.

## CHAPTER IV.

### THE LIBRARY.

TOGETHER with the liberal provision which has been made in the School of Forestry in the Escorial, for the prosecution of studies prescribed for candidates for admission into the corps of Forest Engineers in Spain, inclusive of an extensive museum, with apartments devoted to the exhibition of implements and objects pertaining to each department of study, and appropriate laboratories, there is a spacious library, richly furnished with works treating of all the subjects embraced in the course of study. From the work of Senor Castel on the foundation and development of the school it appears that in 1877, when that work was published, there were in the library 2505 scientific and professional treatises, comprising 5349 volumes of letterpress, and 316 atlases of plates, diagrams, and maps, pertaining to these works.

In these works there are supplied the means of prosecuting the study of any or all of the subjects brought under the consideration of the student in the class, or otherwise engaging his thoughts—

- 659 treated of Mathematical Sciences ;
- 231 of Physics ;
- 1189 of Natural History ;
- 182 of Ethics and Politics ;
- 71 of Literature and Language ;
- 83 of History and Geography ;
- 24 of Arts and Manufactures ; and
- 66 were Encyclopædias or classed as Miscellanies.

The numbers have been increased since then, and every branch of study is well represented.

## SECTION 1.—STUDIES OF FIRST YEAR.

As has been stated, the studies during the first year of the professional course relate to Topography, Integral and Differential Calculus, Descriptive Geometry, Applied Mathematics and Applied Chemistry.

*Sub-Section 1.—Applied Mathematics.*

In the Library there were 6 works on subjects pertaining to Mathematics, 218 on Pure Mathematics, and 435 on Mixed and Applied Mathematics; in all, 1015 volumes.

*Sub Section 2.—Applied Chemistry.*

Amongst subjects to which attention is given in the study of applied chemistry is Tannin.

A good illustration of the mode and exhaustive character of the instruction given in Applied Chemistry is supplied by a treatise on Tannin by Professor Don Carlos Castel, which is at the command of the students. The subject in this is thus stated:—To determine the intrinsic value of the tannin or astringent substances pertaining to tannin, produced by the vegetables of five or more of the province of Spain, and in regard to each to state with the nearest approximation attainable, the age of the plant, and thereafter its growth, habitat, seasons of the year most favourable for the collecting of the produce, and the routes or means of export or transport of this to market; a treatise adopted by the Royal Academy of Exact Physical and Natural Sciences at their annual meeting in 1876.

In the introduction to this treatise, citing words with which M. J. Pelouse in 1833 opens his valuable work on tannin and its sources, to the effect that there is no organic substance, in regard to which there have been so many enquiries, and yet in regard to which the history is so greatly desiderated—Senor Castel cursorally reviews what had been done by chemists in different countries during the forty years pre-

ceding the date of his memoir. In successive chapters he discusses the nature and properties of tannin; the question, Is the tannin contained in different vegetables identical? and the physiological action of tannin. Treating next of analysis, he states the general ideas involved in these; examines different methods of analysis; and gives—1. A detailed exposition of the methods of Monier and Lowenthal; he then gives tabulated results of analysis performed to determine the quantity of tannin contained in different plants; analysis performed by various observers giving the popular and scientific names of the plants; conditions of the plant in regard to age, or aught else deserving of notice, in regard to the season of the year at which the bark was collected, &c.; the part of the tree subjected to an analysis, the percentage of tannin obtained, and the name of the experimenter. 2. Analysis made by Neubauer, giving specification of bark operated on; the percentage of tannin soluble in cold water; the additional percentage obtained by solution in warm water, and the sum of the two. 3. Analysis made by T. Hartig, in regard to which are specified relating to the material, a number of particulars, including the part of the oak whence each was taken, fruit, bark, leaves, or roots; the character of the forest—timber-forest, coppice-wood or medium; from what part of the tree the bark was taken, the degree of shade under which it grew, and the season of the year at which it was collected—some of these particulars being given in regard to some, others in regard to others, of the specimens operated on, and all of these strictly classified. There are stated then the quantity of extract obtained from a gramme of material in the open air, according as this was in winter, or spring, or in both; next, the tannic acid contained in one gramme of dry material, as calculated by the volumetric method, and as calculated by precipitation, and in both cases according as it was in winter or in spring, and in many cases in both. 4. Analysis of plants gathered in Spanish localities, in which are given the names of the plants; the province and the *pueblo* or

township; the age of the plant; the month in which it was gathered; the portion or part of the plant analysed; the colour produced by the salt of iron, and the tannin contained in 100 parts of dry material; and the results of experiments on the influence of light.

In the next chapter are discussed tannin plants, and causes determining the greater or less abundance of tannin, under the headings of general ideas, flowers, fruits, leaves and galls, barks, and determination of the times most favourable for the debarking of the trees in regard to the conservation and development of these; does the richness of the barkings vary with the season in which the debarking occurs? the age at which the debarking should be executed, and the methods of utilisation most convenient for the Casquizales; the influence of heat, humidity, soil, and light on the production of the tannin; methods of disbarking trees. And the chapter closes with a detailed account of the principal lignous plants made use of in the tannin industries.

## SECTION 2.—STUDIES OF THE SECOND YEAR.

The studies of the second year embrace, as has been stated, theory and application of Mechanics, Geodesy, Meteorology and Climatology, Construction and Drawing.

### *Sub-Section 1.—Meteorology and Climatology.*

In Spain, as in other similarly situated countries—in which are included some of our colonies and dependencies—questions connected with meteorology and climate, and as pertaining thereto, means of preventing disastrous consequences from drought, torrents, and inundations, and of securing an equitable diffusion in time and space, if not also an increased rainfall, and humidity of soil and climate, are of importance.

In illustration to what students have thus been trained to attempt and accomplish, I may refer to papers of

forestral, meteorological, and other cognate subjects, by Senor Don Rafael Alvarez Sereix, member of the Corps of Forest Engineers, an *élève* of the School of Forestry, and now Director-General of Geography and Statistics in Madrid, which have appeared in Spanish periodicals, and been re-published in two series, entitled *Estudios Botanico-Forestales*; and others which have been published in a volume entitled *Cuestiones Cientificas*, copies of which are at the command of the students.

One of the papers published by Senor Alvarez, under the title of *Estudios Botanico-Forestales*, is entitled 'The Influence of Forests on Climate,' based on the valuable treatise on the subject by M. A. C. Becquerel. In this the term rendered forest is used as one applicable to a considerable extent of country covered with a spontaneous growth of an arborescent vegetation. And following Humboldt, the author says the climate of a country is the result of the calorific, aqueous, aerial, luminous, and electric phenomena, which may cause one determinate locality to present a different meteorological character from another of the same latitude and geological conditions.

Assuming that of the influences specified heat exercises the greatest influence, and next to this the quantity of the rainfall in the different seasons of the year, and next to these the humidity or aridity of the air, the predominating winds, the number and distribution of storms in the course of the year, the degree in which the heavens are clouded, the nature of the ground, and of the vegetation covering it, and whether this be spontaneous, or the result of culture, Senor Alvarez proceeds to discuss the questions which will determine what is the effect of woodlands on the climate of a country, which questions he assumes to be these:—

1. In what degree do the forests act as a protection against the winds, and in what measure do they retard the evaporation of the water of the rainfall?

2. How do they modify the hydrometric condition of the surrounding atmosphere by absorption by roots, and by evaporation from leaves?



3. How they modify the temperature of a country?

4. Have forests any influence on the rainfall as to its frequency, or its abundance and distribution, and do they regulate more or less equally the flow of streams and springs?

5. To what extent do they prevent the erosion of mountains and lesser slopes?

6. Do forests draw off electricity from thunder-clouds, and if they do so do they to an extent corresponding to this action effect the region of the woodlands? And

7. What kind of influence do they exercise upon the public health?

But with these preliminary points determined it is necessary, he says, in order to determine the effects of forests on any district, to know also the geographical position of this, its geological character, its latitude, its proximity to or distance from the sea, the composition of its soil, and of its subsoil, and whether this may be permeable or the reverse—calcareous or argillaceous—all of which particulars can only be determined by observation. And he further states that the action of forests on the climate will be more or less pronounced according to—

1. The extent, elevation, and nature of the soil and subsoil.

2. Its exposure in regard to heat or cold, and in regard to the humidity or aridity of the winds.

3. The season of the year in which fellings are made; whether the kinds of trees be those with deciduous, or with persistent leaves; and the evaporation and radiation going on in the different seasons.

4. According as the season of rains be the spring, the autumn, or the winter; and

5. The proximity of pestilential lakes, &c.

All of these points are discussed in an exhaustive manner, commencing with a permeable soil with a permeable subsoil, and a permeable soil with an impermeable subsoil; and an impermeable soil with a permeable subsoil, and an impermeable soil with an impermeable subsoil.

Another of the papers published by Senor Alvarez is one under the title *Trabajos de Ebermayer*. On the works of Ebermayer, in which are discussed successively the influence of forests on the humidity of the atmosphere; on the humidity of the ground; on the temperature of the ground; on the temperature of the atmosphere; and on the constituents of the atmosphere.

The views of Ebermayer are also brought forward at great length in a brochure entitled *Breves Consideraciones sobre Estatica Quimica*—Brief remarks on forestal chemical statistics—by Senor D. Luis de la Escosura y Coronel, Chief in Corps of Forest Engineers. In this the author sought to give as detailed an analysis as possible of the valuable work by that distinguished Professor of Agricultural Chemistry and of Geognosia, in the Royal Central School of Forestry at Ascaffenburg, entitled *Die gesammte Lehre der Waldstreu, mit Rucksicht auf die chemische Statik des Waldbaues. Unter Zugrundlegung der in dem Koenigl. Staatsforsten Bayerns angelstellten Untersuchungen*—a work, to follow a description given of it by M. Grandeau, methodical in the highest degree, and written with sobriety and lucidity, the perusal of which is lightsome and interesting, notwithstanding the numerous statistical and analytical data which it contains; and beyond all manner of doubt one of the most important forestal works of our age.

The author commences with the study of the formation of the covering of the forest ground; that is of the conditions of the fall of the leaves, comprising the causes, the times, the quantative importance according to species of trees, the altitudes at which they grow, &c. In the second chapter he takes up the data procured by analysis, in reference to the chemical composition of the ground covering, and of the wood; determining thus the chemical statistics of the forests. In the third he brings under consideration the physical properties of that covering, and the influence which this exercises on the physical properties of the ground. In the fourth, attention is given to

chemical modifications experienced in the ground-covering of forests, and its chemical action on the ground. In the fifth and last chapter are brought under consideration the influence on the forest of the removal of the leaves and other *debris* constituting the ground-covering of the forest. In an appendix is given a statistical comparison between agricultural and sylvicultural productions, and tabulated statements of numerous data which had served as a basis for the conclusions of the author.

In 1879 was published a brochure entitled *Inundaciones y sequias medios de defensa—Informe redactado por acuerdo de la Junta Directiva de la Sociedad Geografica de Madrid, con motivo de la Inundaciones de Murcia; por El Exmo. Señor Don Frederico de Botello y de Hornos*—which is full of important and interesting details, illustrative of the production of torrential rains, and consequent torrents in mountainous regions, and wide-spread inundations on plains; all which, it is shown, might in many cases, if not also in every case, be prevented by planting the basin receiving the rainfall with herbage and bushes and trees.

In the following year (1880) was published, *Lluvias e Inundaciones: Distribucion general de las aguas en toda la superficie del globo y particularmente en Espanna; Torea de las Avenidas, de los rios y medios de evitarlas y resistirlas; por D. Vincentè de Vera y Lopez, Doctor en Ciencias, Quimico del Ayuntamiento de Madrid; con un prologo, de D. Manuel Maria Jose de Galbo.*

After notices of the general distribution of the rainfall over the surface of the globe, and illustrations of the effect of circumstances upon this, the author takes up the consideration of the rainfall in different regions in the Peninsula, and the local conditions of these. There is given then an exposition of the theory of floods, with details of the action of geographical position in regard to latitude on varying degrees of humidity in the atmosphere; of the influence of the geological character of the ground;

details of different phenomena of rivers flowing over permeable and impermeable lands; of the action of vegetation on the rainfall. Passing then to the consideration of great inundations, details are given in regard to inundations of the Amazon, of the Mississippi, and of inundations within the temperate zones, and local conditions by which they are affected. The author next proceeds to the consideration of torrential inundations in Spain, in Almeria, and in the basin of the Lorga; floods of the Sangonera and of the Segura; floods in the great Cuencas; inundations of the Duero and of the Rodano; and the inundations of 1857. Information is given in regard to the effects of inundations, and to the alluvial deposits left by inundations. There follows a review of the hydrography of the Peninsula, in which it is shown that to the mountainous character of the country is attributable the fact that there are no great rivers there; with notices of the various slopes of the country toward the sea, and of the districts included in each. In discussing means of preventing inundations there are brought under consideration, in succession, the contour of the country, and the effects of vegetation; the geological character of the ground in each locality; the permeability of the ground, *pantanos*, or large reservoirs; lateral or littoral deposits; canals; the riches lost in the sea; and the extent to which the water might be utilised.

In the conclusion of the work the author refers to the importance of international arrangements of meteorological observations, and of works designed to prevent the abrasion of the banks of rivers by dykes and other works of defence, a measure which had commanded attention in many countries.

The advanced forest economy of the day is based on scientific observations, and scientific reasoning. In the first-formed schools of forestry, such as those under Hartig and Cotta, observation was combined with instruction and practice. The importance of this was felt deeply by two German foresters, Handshagen and Von Wedekind, and in

1826 the latter made an effort to organise a society to conduce to prosecuting forestal experiments, but did not succeed. In 1868, at a congress of German foresters, held in Vienna, the subject was brought under discussion. A committee was appointed to consider on what plan such forestal experiment stations as were considered desirable should be organised. 'They agreed'—says Mr Adolphe Leue, in a paper read before a Convention of the Ohio State Forestry Association, held in Cincinnati in August, 1883—'On a plan of organisation, and questions to be subjected to investigations and experiments. The report was adopted by the German Foresters' Congress, and submitted to the several Governments, which were to bear all the expenses of these stations.

.....  
 'The first station was organised on the 16th April, 1870, at Baden, Saxony, Prussia, Wurtemberg, Austria, Bavaria, Brunswick, and Hesse followed in the order mentioned.

.....  
 'The great aim of these stations is,' he says, 'to furnish a scientific foundation for a rational management of forest, based upon exact experiments and careful investigation. They are intended to determine the significance of forests in the economy of nature, to try the various methods of forest management, to examine the advantages which one method may have over the other, and, finally, to establish a plan of forest administration, which will enable the owners of forests to realise the greatest possible profit from forests, and at the same time reduce the expenses of their administration.

'Among the many problems to be solved through the agency of these stations, are the following: to determine the influence of forests upon soil and climate; to investigate the relative value of the several methods of thinning; to establish reliable tables of increase, and methods of valuing forests; to study the foes of the forest, both animal and vegetable, and to devise means of successfully com-

bating them ; to determine the value of forest-litter upon the growth of trees ; to test the relative value of forest implements ; to devise new methods of obtaining forest products, and to find new uses for the same ; in short, they are intended to furnish the means by which to increase the wealth of the owners of forests, and thus that of the entire country, and to furnish legislative bodies with the foundation necessary for a just taxation of forests, and for a wise and beneficent code of forest-laws.'

These stations are State institutions, connected with schools of Forestry.

In Prussia, with the Forest Academy at Eberswalde.

In Bavaria, with the University at Munich.

In Saxony, with the Forest Academy at Tharandt.

In Wurtemberg, with the University of Tübingen.

In Baden, with the Polytechnicum at Carlsruhe.

In Thuringia, with the School of Forestry at Eisenach.

In Hesse, with the University of Giessen.

A desire was felt by *élèves* of the School of Forestry in Spain that they should be enabled to join the union, and take part in the prosecution of observation and experiment ; and that to them should be allotted observations connected with meteorology and climatology : and in 1882 was published, under the title *Estacion Meteorologica-Forestal de San Ildefonso*—a project for the creation of a Meteorological-Forestal Station in San Ildefonso—which had been presented to the Minister de Fomento in the year 1874, by the Commissioners entrusted with arrangements for the systematic management of the forests of Balsain, a royal appenage in the vicinity of Madrid, lying between that city and Guadalajara. Having stated and detailed the origin of the union, the writers add : 'Since September, 1872, there have been conformed and brought into reciprocal communication the stations of Prussia, with those of Wurtemberg, Baden, Hesse, Bavaria, Saxony, and

Thuringia, according to an agreement adopted at a re-union of German foresters held in Brunswick. The stations in Prussia are ten in number, besides other three which have been created in Alsace-Lorraine. The regulations of these stations were made on 11th March, 1872, and according to the arrangements made the central station is organically united to the Academy of Forestry in Neustad-Eberwald; and all the others are subordinate to this. In general, the studies or investigations are divided into five sections—the forestal, properly so-called; the chemico-physical; the meteorological; that of vegetable physiology; and zoology. But the central station has the whole of these sections, the others have only forestal and meteorological sections, or only one of these.

Referring then to the stations in Bavaria, under the direction of Dr. Ebermayer, as models deserving of imitation, there are stated the points to which attention is given in these; and the results which might be expected from the consideration of data obtained. There are next described what apparatus it would be desirable to have, and suggestions are submitted in regard to the organisation and service of the station proposed, with an estimate of the prices of at which the apparatus might be procured in Munich, amounting in all to 1570 pesetas or francs—of the expense of establishing the observatory amounting to 550 pesetas, and of the probable annual expenses amounting to 2150 pesetas. So far as known to me nothing resulted from this memorial in the form submitted for consideration; but the matter to which it had reference has been taken up, in connection with the other arrangements made for the study of aspirants to the forest service of the country, in the School of Forestry in the Escorial.

*Sub-Section 2.—Construction.*

In the same year, under the head of construction, attention is given to the construction of forest-roads and highways, bridges, sheds, forest huts, and homes for forest officials,

who are required to reside permanently or occasionally within the precincts of the forest; and to works of hydraulic engineering: wells, tanks, canals, and works of irrigation. In connection with the information which has been given in regard to published works, to which the students have access, on matters pertaining to meteorology and climatology as departments of forest science, I think it well first to make mention of works on hydraulic engineering, and thereafter to advert to works connected with the others.

Of treatises on subjects pertaining to hydraulic engineering the most instructive is one entitled *Tratado de aguas y Riegos, por Don Andrés Llaurodo, Ingeniero de montes Jefe de Primeri Clase, Professor de Construction y Mecanica Aplicata en la Escuela especial der Cuerpo, &c., &c.*—A treatise on rivers and irrigation works, by D. Andrés Llaurodo, Chief of the first-class in Corps of Forest Engineers, and Professor of Constructions and Applied Mechanics in the School of Forestry. It is a treatise which, published in 1870, has reached a second edition, and meanwhile has procured for the distinguished author high honours in orders of knighthood in his own country, in Portugal, and in France and Italy,—and membership in numerous scientific and agricultural societies in different parts of Spain, in Russia, in Italy, in Piedmont, in France, and in the United States of America.

After an introduction, in which is given a brief review of irrigation works in Spain, and a statement of economic considerations involved in the enterprise, and of means by which it might be further developed, the author devotes the first part of his treatise to preliminary matters, discussing in successive chapters:—1. The importance of irrigations, and the climate of Spain. 2. The composition and nature of waters of irrigation, and their effects on vegetation, and on different crops. 3. The quantity of water required for irrigation. 4. The price of recovering water, and employing it in irrigation. 5. The current or flow, and the leading



off of water. 6. The distribution of water led off, and the effecting of this in determined proportions. 7. The distribution of water in fixed quantities.

The second part is devoted to the consideration of means of procuring water, in regard to canals of irrigation; and after determining preliminaries, there are discussed schemes of operation and works of execution. In regard to reservoirs, there are discussed certain general principles connected with them, and the construction of them; followed by an account of reservoirs in Spain. Fountains or springs from subterranean sources are next discussed, with special reference to the discovery and opening up of subterranean supplies; the geological strata, and the general conditions of the strata in which they exist; the directions in which the water flows in subterranean channels; the most favourable points for discovering these; the depths at which they exist; the delivery which may be expected from them; rules proposed in olden times for discovering and opening up such supplies; and different methods which have been employed in modern times; artesian wells; raising of water by mechanical appliances; machines which are in use.

The third part is devoted to irrigation, and there are discussed the irrigation of arable lands, and of meadows. In connection with the latter are discussed certain preliminary matters; general ideas regulating the operation; and methods employed.

The fourth part is occupied with the reclaiming or improvement of wet lands. Here are brought under discussion drainage; warping; drying up of lagoons; reclaiming of land from the sea; the planting of sand dunes in Andalusia; and the reclaiming of salt soils.

Such are the contents of the first book. The second book is devoted to works of irrigation in Spain. In succession are brought under consideration those on the Northern or Cantabrian slope of the country; those on the Western slope; those on the Southern Oceanic slope; those on the Southern Mediterranean slope;

and those on the Eastern slope. In regard to each information is given relative to the lands and water supply, and to irrigation works of every description mentioned in the previous book to be found in the basins of the different rivers by which it is traversed.

There are several works on irrigation, and matters pertaining thereto, in the Spanish language, and distinct references to these are given, in some cases with copious citations.

Under the head of forestal construction, in the programme of study followed in the School of Forestry, is comprised also the construction of forest huts and homes.

In connection with this department of study there were published in 1882, *Proyecto de una casa, para Guardas de monte y Capataces de Cutivos, en la Dehesa del Moncayo de Tarazona, por José Bragat, Ingeniero, Jefe de montes y Jefe del Distrito Forestal de Zaragoza*; and in 1885, *Proyecto de casa de Guardas ara el monte Pelonno*.

And in illustration of the character of the studies pursued in this department, I may cite these projects, and estimates for the erection of foresters' houses. The first is a project for the erection of forest cottages for forest warders, and foremen superintending planting operations in the pasture lands of the Moncayo of Tarazona. In this are given details of the zone of the Moncayo; of the pasture grounds in question; of forests comprised in these, or adjacent thereto; and such information in regard to all of these as might be deemed necessary to the formation of a correct opinion of the necessity or importance of the work. The papers to which this is introductory consist, in accordance with Article 8 of Regulations for the carrying out of the law of 11th July, 1877, of specifications of the works required; of the materials to be employed; of the manner in which the works are to be executed; and general arrangements in regard to reporting the progress of the work, and the taking over of this when completed. It was prescribed that the work should be done by contract,

and executed within a specified time; and there are appended to the specifications a tariff of different wages to be allowed to different kinds of workmen; of charges for means of transport of material, including drivers; and for lading, transporting, and discharging the loads, based on the cubic measure of the whole, or by cubic metre per kilometre of distance; of payments to be made for excavating earth, according to specified unit of measurement; a statement of the average distances of transport from different localities, with accounts of the quality of the materials yielded by each; the condition in which these exist, and that of the state of the roads from those to the site of the building; and a statement of the expense of the several works, according to these estimates, with a summary of the whole, which amounted to 6499·15 pesetas—to which was added, to cover unforeseen expenses 1 per cent. 64·99; expense of direction and administration 5 per cent. 324·96; profit to contractor, including 3 per cent. for money advanced, 9 per cent. 584·92; in all, 7474·02. To the whole are added general directions issued by the directory of public instruction, agriculture, and industry, to be followed in the erection of the house.

The project and specifications, and estimates, included the furnishing of a room for the use of the forest engineer when visiting the district. This comprised a sofa, bedstead and bedding, wash-stand, cupboard, writing table, lamp, drawing-board, and all requisites for the preparation of charts and reports—the sum allowed for all which was 400 pesetas, and this was included in the general estimate.

The second was a project for a warder's cottage in the Pelonno forest, with plans and elevations. In this the preliminary statement was more brief, but the tabulated statements more full. These comprised specifications of measurements; estimates of expenses of each kind of work, according to unit of measurement; general estimate of the whole, and summary, with additions of 5 per cent., and of 9 per cent., giving a total of 100·86 32 pesetas.

## SECTION 3.—STUDIES OF THIRD YEAR.

In the third year of study attention is given to Mineralogy and Applied Geology; to Applied Zoology; to Applied Botany; and to Sylviculture.

*Sub-Section 1.—Mineralogy and Geology.*

Besides other works on geology and mineralogy, there has been published under the title of *Lecciones de Petrographia Aplicada Explicada en le Escuela Especial de Ingenieros de Montes por el Ingeniero del Cuerpo y Profesor de la misma D., Juan José Munnos de Madariago*, Lectures on Applied Petrography expounded in the School of Forest Engineers by Senor Munnos, Forest Engineer and Professor of Mineralogy in the school. In this are given details in regard to some 600 different rocks, including the scientific and the popular names under which they are known, and is a work spoken of in terms of high commendation by the Junta Consultativa, or Council of Advice, of the corps, by which the publication was recommended.

In this volume, after some preliminary observations, notices of the bibliography of the subject, and a definition of the designation, there are discussed:—

1. Under the head of Hilology the division of rocks according to their constitution, with the distinction between phaneromeric and cryptomeric rocks.

2. Under the head of Histology there are discussed the forms and dimensions of the elements of rocks; the forms and structure of accessory masses; the general forms of structure; particular structures of rocks; cross sections and fractures.

3. Under the head of Morphology are discussed forms of stratification, of aggregation, and of concretion.

4. Under the head of Synopsis there are given the classification of Naumann, with a tabulated classification of the rocks according to this; the classification of rocks, according to Cordier; the classification of rocks

considered mineralogically, according to Broignart ; the classification of rocks considered mineralogically according to D'Omalius ; D'Halloy ; the mineralogical classification of rocks according to Coquand ; the classification of Coquand modified by Vilanova ; and the dichotomous classification of rocks. The different species are then described according to classes, and orders, and families.

5. Under the head Petrogenia are discussed successively eruptive rocks and neptunic rocks, in a normal condition, divided into those formed by chemical sediment, and those by mechanical sediment ; metamorphic rocks, and rocks of organic origin, divided into those formed of animal remains, and coal formations of vegetable origin.

6. Under the head of Aleofologia, or the decomposition of rocks, are discussed the various rocks thus produced. And this is followed by a discussion of the general constitution of earths ; of the component parts of these ; of the influence of these upon the properties of the earths thus formed ; the physical properties of earths ; and the classification of earths according to the method of Hundeshagen of Masure, and of Columelo.

Of this sixth section of the work the Junta Consultiva speak in terms of the highest commendation.

It appears from their statements, and the statements of others, that facts which are met with scattered and dispersed in various treatises on sylviculture, mineralogy, geology, and other allied subjects, are here presented in such collocation and combination that with ease and advantage there may be deduced from the composition of the soil the vegetation with which it should be covered, and *vice versa* ; and be determined with certitude the case frequently submitted to the forest engineer—to what should be destined certain lands requiring to be replenished ; or what species of trees should make way for others for which the land is better adapted : and this department of study is presented in the work in a simple and attractive aspect,—deducing so naturally from the composition of the soil, and the course of the alterations in the nutritive principles

which it contains, and from its qualities, physical, chemical, and mechanical, the requirements which should be satisfied, and the relations which, within definite limits, should exist between the soil and vegetation which it prefers—that in this part of the work the forest engineer has a safe guide in the discharge of one of the most important of the services required of him. They allege that Senor Munnos has (it may be unintentionally, but not on that account the less meritoriously) so carried out his idea as to elevate it to a place amongst those ideas which are of much avail in the development of the practical applications made of physical science; showing that appliances which are oftentimes found to be a burden on the memory appear as corollaries or consequences like to those which are derived from mathematical problems, and satisfying suspicions and doubts which naturally arise as the horizon is extended, by the demonstration that what happens could not but happen, and could not have been brought about otherwise.

*Sub-Section 2.—Applied Zoology.*

Like attention has been given to provision for the study of Zoology and Botany in their application to forestry. An extensive acquaintance with both sciences is a pre-requisite to admission to the school in the Escorial, but the information otherwise obtained has to be brought to bear upon phenomena presenting themselves to the forest engineer in the discharge of his functions, so as to secure the conservation and healthful development of forests under his charge or administration.

What may be considered a handbook, which may be used in diagnosing vegetables and animals coming under his notice in connection with his profession, as might be used the Petrography of Munnos in diagnosing rocks and soils, is a volume entitled *Claves Dicotomicas, para la determinacion de los typos, ordenes y Familias, en los reinos, animal y Vegetal*, by Senor D. Adolfo Parada y Barreto, Forest

Engineer-in-Chief of the second class, and Professor of Applied Zoology in the School of Forestry.

And information in regard to methods of prosecuting microscopic investigations, so necessary in the study of entomology, in relation to injuries done to forests by insects, is embodied in a volume printed by Royal order, under the title *La Estacion Zoologica de Napoles, y sus procedimientos, para el examen Microscopico*, 'The zoological station at Naples, and its proceedings by microscopic examinations—a memoir presented to the illustrious the Director-General of Agriculture, Industry, and Commerce, by Don Joaquin Maria de Castellarnau y de Lleopart, Forest Engineer.

Illustrations of the practical application of a knowledge of entomology, to the study of damage done to forests by insects, are supplied by a memoir entitled, *Estudia de la Invasion de los Montes de la Provincia de Salamanca, del Insect llamado vulgarmente Lagarta, y medios mas adeocuardos, para evitar sus estragos*—A Study of the Invasions of the Forests of the Province of Salamanca, by the insect popularly called *Lagarta*; and the most efficient means of averting its ravages—by Don Antonio Garci Maceira, Forest Engineer-in-Chief of the second class.

In consequence of great devastation being occasioned in the forests of Salamanca by an insect, the increase and spread of which was imperilling the existence of the woods and forests in the province, by Royal order of 21st May, 1883, a commission of enquiry was appointed; and Senor Maceira was entrusted with the commission. He proceeded to the province, prepared a report, which was submitted for examination to the Facultative Junta, or Professional Council of Forests, by whom it was highly approved, and its publication for general information was advised. This approval and advice were forwarded by the Director-General of Agriculture, Industry, and Commerce, to the Minister of Fomento, and publication followed.

In the memoir by Senor Maceira there is given the history of the invasion and its rapid spread; there follow

notices of the generic and specific characters of the insect, and of its natural history, with general observations on the causes and occasion of its rapid increase in the province. There are adduced climatic observations, with statements of contributory effects, direct or indirect, which climatic conditions may have had in favouring the rapid increase of the insect. There are next stated effects which may be attributed to the diminution of carnivorous insects, parasitic insects, and insectivorous birds, with references to the occasion of this. Next are specified extensive changes which had taken place in the culture of different crops in the district, but not in adjoining districts, with the effects of diminishing the woodlands in it, and so affecting the climate; of starving out certain insects, and as a consequence diminishing the aliment of insectivorous insects and birds; and, as a second consequence, leading to the diminution of these, but increasing at the same time the vegetation supplying food for the *Lagarta*—the *Bombyx Dispar* of Latreille, the *Liparis Dispar* of Linnæus; and thus producing an extraordinary increase of the insect, and of its ravages in the forests, with disastrous consequences. Next, with courtesy but firmness, there are reported as contributory causes the apathy and negligence of the people; the unsatisfactory condition of the municipal guard as forest watchmen, and that of watchmen supported by private proprietors of forest lands; and in connection with this the inefficacy of the law as it exists to secure the destruction of injurious insects; and the desideratum of associations of forest proprietors and foresters for consultation and action in matters affecting the interests of owners of forests and woodlands.

A more commanding illustration of the application of the knowledge of entomology to the averting of a threatened calamity is supplied by what occurred to Spain, on the invasion of Europe by the *Phylloxera vastatrix*. In many of the vine-growing communities of Europe, on the appearance and rapid spread of the *Phylloxera*, there was great



and wide-spread consternation, and that not without reason. Spain was not an exception to this panic, but at once the forest engineers in various parts of the country came to the front spontaneously, or at the call of the Government, or the entreaty of their compatriots, and the result showed that they were thoroughly competent to deal with such a case. It would fill a volume to detail what they did in prescribing and advocating preventive protective measures, which were adopted and proved efficient; and what they did to expose the insufficiency or other means which elsewhere had become famous. Details of what was done in both of these departments of operations are embodied in a report, published by Government, by His Excellency Senor D. Mariano de la Paz Graells, Professor of Comparative Anatomy and Physiology, in the University of Madrid, entitled *La Phylloxera vastatrix*. In it is a large volume with an atlas of illustrative plates. It gives details of the natural history of the insect; of what had been published in regard to it elsewhere; and of what had been done to avert the evil in Spain and different parts of Europe.

*Sub-Section 3.—Applied Botany.*

As with the provision made for the study of Applied Mineralogy and Applied Zoology, so with the provision made for the study of Applied Botany. It was, as might have been anticipated from the immediate relation of botany to forestry, still more copious.

One valuable contribution to the provision made for aspirants to the membership of the corps of Forest Engineers, enabling them to make themselves acquainted with the latest discoveries in modern forest science, are various publications by Senor D. Rafael Alvarez Seriox, of some of whose writings mention has been made. Amongst these are *Geografia-Botanica*; and *Estudios Botanico-Forestales*. Of the latter two series have been published, most of them

being translations or *resumés* of papers or larger works by men of note in other lands, given in a flowing popular style, attained without detriment to the scientific precision of the original—or papers giving the result of his own observations, or of observations made by others under his eye.

With these may be classed one entitled *Incursion por la Botanica*. Of this, the following translation will supply a better idea of his treatment of such matters than I could give by a brief notice or summary. The design was, as may be seen, to supply an indication of the state of botanical science among students of forest science; and taking as a motto that line of Virgil, *Felix qui potuit rerum cognoscere causas*, he proceeds:—

‘The vegetable world presents to the view of the attentive observer who studies it, marvellous charms and mysteries of complicated and but little comprehended organisation; all in beautiful harmony with the eternal Hosannas which heaven and earth are giving forth; producing admiration, and presenting motives prompting the spirit to meditate—the infinitely great, but also the infinitely small; the milky way, with the innumerable stars of which it is formed, but also the microscopic ephemera, which is born, lives, and reproduces its kind, and dies all in a space of time of a few moments duration. So many and such are the transformations of matter brought about by vital force, the reality of which is indisputable although its essential nature is unknown, that not even imagination can grasp such an immense combination, in which it appears as if we found an infinite within another infinite, and in wondrous harmonious co-operation, always working, and always unvarying, the laws by which all is moved by the Sublime Architect of so grand a work.

‘Shall man go on progressing without end? Will there come a time, more or less remote, in which he will be able to give account of the causes originating all that comes under the cognisance of his senses? We believe not. His perfectability is limited with his intelligence; there is

something at the bottom of all the problems which he proposes to himself to solve that is inherent to his own personal imperfection. He does not know the connection of the subjective and objective ideas; and in his laudable endeavour to obtain possession of the truth he encounters obstacles which he cannot remove, and which it is not given him to interpenetrate and fill.

‘It became possible, after a lapse of centuries, and continued observation, to discover the existence of sexes in plants. The middle ages having passed a dark night of human intelligence, Camerer wrote his famous letter in 1694, in which he declares that the anther is the fundamental portion of the flower; and somewhat later, on the 10th of July, 1717, Vaillant delivered an erudite discourse rejecting the hypothesis of Samuel Morland, and affirming that “the stamens transmit to the ovules—not the grains of pollen—but the vapour or volatile spirit, which is emitted by them;” and J. B. Amici examines the *Portulaca oleracca* (a species of the Purslane), and opens to science, with his description of the pollen tube, a wide field for investigation, in which there distinguished themselves Broignart, Schleiden, Fritzsche, Mohl, Hofmeister, Radlkofer, Schaeht, and many other distinguished naturalists. Let us study the progress of fecundation; let even the different speed with which the pollen tube advances from its formation be determined; let it be followed, and be seen to penetrate the microphile, in which it shows a remarkable incisory force—and this having been done, when the triumph seems complete and the phenomena explained, there presents itself the insuperable difficulty of ascertaining what may be the action of the extremity of the pollen tube upon the embryotic vesicle, from which it is kept apart by a membrane which is not perceptibly modified, and the basis being wanting we begin to diverge into the dangerous field of hypothesis—ingenious, no doubt, but it may be far from correct,

‘What a beautiful world is the world of plants! and what a time man has lived without giving to them the attention they claim, believing them to be the gratuitous gift of nature—manna which might be enjoyed without any trouble about its preservation! A silent and solitary world living by itself alone: a beautiful carpet which covers the earth, and forms, with the blue of the heavens, a landscape of charming loveliness such as no painters—not even the most illustrious—have been able to depict and perpetuate upon their canvas! Overwhelming is the thought in considering only the infinity of the numbers of the individuals of which it is composed, from the gigantic Wellingtonia, whose head is lost in the clouds at the height of a hundred metres, and the twisting twining Calamus, a thousand yards in length, to the Moss and the Lichen, which cover with green tints the abandoned lordly towers; or the Algae, which float lightly on the waters of the murmuring brooks. Just as they exist on the burning sands of Africa, and quench by their juice the thirst of the lost caravan, and with their shade protect from the burning rays of the sun, and cover and save from the terrible *Sirocco*, are they found likewise in reduced size in the regions of perpetual snow.

‘It is they which mainly contribute to keep the atmosphere in fit condition for the support of animal life. During the day their cellules, which contain chlorophyll, fix the carbon for the growth of the plant, and set free the oxygen, for which great blessing we are indebted to them as a boon, as thus we owe to them life and unappreciable joy, to which we cling the faster the nearer we are about to finish our pilgrimage and go.

‘Vegetables are also vast deposits of solar heat, which they store up and keep by their chemical action, assimilating it for their growth, and which they subsequently give forth entirely and without reserve, so that, as was affirmed by the unfortunate Lavoisier: In nature nothing is lost, and

nothing created. These mines of coal, of which London consumes annually six millions of tons—what are they but immense antediluvian woods hidden by geological deposits? We can fully enter into the views expressed when interpreting, for the first time, the movement of the locomotive on roads, Stephenson said to Buckland, who was looking on with astonishment, “Do you know what gives movement to this machine? The sun, which more than two million years ago darted to earth with its rays of light, those same fires which are now to-day converting the water into steam.”

‘Blissful nations are ye in which all the importance which it deserves is allotted to the vegetable kingdom, and in which it is studied in its different manifestations, with a view to secure to it all the means of life which it requires.—Nations in which a tree is sacred, and forests are not devastated to meet some momentary requirement, without any eye for the future! Base spirits are they which reckon for merit their hardihood, and their ignorance for glory!

‘A proof of the attention which is now given to these is supplied by the fact that the most abstract theories have been under discussion, and even such as the satisfactory determination of which would, as their only consequence, have brought about a scientific triumph! Known to every one is the marked fixity with which the root tends towards the centre of the earth, and the stem towards the zenith—a constancy which was made the more manifest by the experiments of Duhamel and Dutrochet. Well then, the attempt has been made to gain an explanation of this, Astruc supposing that it was due to an accumulation of sap; Dodard believing that the sun attracted the stem, and the earth the roots; La Hire imagining that the roots direct themselves to the centre of the earth, dragged down by the weight of the nutritious sap, which is reduced to a state of vapour in the stem, through the effect of the elaboration of the plant; Darwin attributing it to humidity; and Knight

making the action of gravity to come into play. If they have not yet resolved the question satisfactorily—if there be still awaiting the theory which will account for the same force of gravitation causing the root and the stem to take opposite directions—the various conjectures manifest at least the power of the human mind, and they are all of them deserving of commendation.

‘More important, doubtless, it would have been to have been able to determine whether vegetables possess the property of selecting the nourishment which suits them, and refusing what would be noxious; or whether, on the contrary, they absorb all indiscriminately. And great advances in the somewhat complicated art of cultivation would have been made if we had been able to discover whether vegetables excrete at the extremity of their rootlets, and what it is which they excrete. Although it is nearly a century since Brugman submitted to botanists his views on this last point, and although Macaire, Chatin, Meyen, Garreau, Brauwis, Goldman, Sachs, Unger, Walser, and others, have studied the matter judiciously and carefully, we only know after all that the *Rotation of Crops* of De-Candolle has no certain basis to stand upon, having been followed because it was expounded by so illustrious a master—as genius, like the sun, blinds its satellites, and leads them blindly to follow on, without subjecting their procedure to reason.

‘Another problem, however, and that one more difficult to solve, is to determine clearly whether plants have feeling. In presence of the phenomena presented by curious movements, and special attitudes, it is customary to say that these are caused by the irritability of the tissues, but never by sensibility, which is generally repudiated as an absurd hypothesis; but, bear with me if I ask: Where does sensibility terminate, and irritability begin? What are the limits which separate them? It is an old trick of man to try to cheat himself by the employment of words which do not express ideas explicitly. We may feel assured

that it is not known in any determinate manner why the name has been given to what is called *The sleep of plants* (*The Somnus Plantarum* of Linæus), and what difference of constitution occasions this phenomenon so pronounced in some, and imperceptible or wanting in others. When the sun declines below the horizon, and the long twilight comes on, it may be observed that the leaves of certain species of plants, as those of the *Cassia floribunda*, turn their leaflets in such a way that they approximate one another considerably, a movement which is generally manifested by the acacias, which are extensively cultivated in our gardens as an ornamental tree: And who has not heard of the sensitive plant, *Mimosa pudica* L., whose movements, like the natural and periodic ones of sleep, are originated so easily by a passing cloud obscuring for a time the light of the sun, or the distant galloping of a horse, or by the excitation which an insect produces by alighting on the leaves? Who is not aware that it is enough to touch the extremity of one of its leaflets, in order that all the leaves, and even a branch, close up as if frightened by the imprudent mortal who has taken the liberty to come near it?

Remarkable also are the movements of the *Hedysarum girans* L. (*Desmodium girans* D.C.), a curious plant, discovered in Bengal by Lady Monsen, in which a large odd leaflet is in constant motion; and the other two, a good deal less in size, keep up a lively oscillation of a peculiar kind, on which the vertex, or extremity, of each describes an elipsis—the plane of which is oblique to the axis of the leaf. And we may lastly cite the *Dionæa Muscipula* L. (the Venus Trap-fly), which, together with the *Drosera*, the *Saracenia*, and the *Nepenthes*, has by its movements given rise to a lengthened controversy, in which Darwin, Hooker, Rees, and Will, have displayed their genius and vast experience, as they have discussed with all earnestness the fact whether they be carnivorous plants or not.

In 1866, Ligersan and Divers having made curious experiments on the sensitive plant, found a remarkable

relation between the movements of this plant, and the nervous system of man, and believed the influence to be in its origin of the nature of magnetism. Ligersan experienced a painful impression, produced or communicated apparently by this plant, it being observed that its contractions were more rapid and persistent through contact with an organic body than through contact with a mineral.

‘To bring to a close these unconnected statements, imperfect expressions of unconnected ideas, it is but right that we should give place to the immortal Gœthe, poet and naturalist, and author of the theory of Morphology, which is now almost universally accepted. He sings one of his beautiful compositions in memory of Schiller, glorious son of Germany, and says eloquently: “The coloured leaf feels the divine hand, and contracts on being touched; its slender forms enfold themselves, and find themselves destined to embrace; they appear in graceful pairs re-united around the sacred altar. Hymen covers them with his wings; and with the diffused precious aromatic perfumes they are deliciously inebriated; and then they develope in seed the numerous germs which the ovaries enclose.

“Thus uniting themselves as a new link to that which went before, the mysterious chain is carried across our times, and the type is preserved as well as the individual.

“Turn now, friend, never to be forgotten, thy gaze to the whirlwind which is agitating all around thee, and to thy spirit there will be nought of confusion: every plant will speak to thee its eternal laws; every flower will speak to thee in language more explicit; and if thou knowest how to read in them the thoughts of the gods, thou shalt know how to comprehend them in all their parts, and under whatever form they present themselves—the same in the hydra, which turns round embracing itself, as in the butterfly which disports itself in the sunshine, and in man, who artificially disfigures his true physiognomy.”’

A second paper, by Senor Alvarez, in this department of



study—Applied Botany—written more in the severe style of the scientist in dealing with the data and scientific deductions of inductive science, than in that which befits the expression of emotions called forth by the contemplation of discerned truth, is one entitled *Causas de la Ascension de la Savia*, or sap, based on the able works of Dr Boehm.

Another paper by Senor Alvarez which I may cite in illustration of the character of the studies in research pursued in this department of forest science in the School of Forestry in the Escorial, and of the kind of publications to which students may have access in the prosecution of their studies, is one entitled *Temperatur del Arbor*, Temperature of the tree. The following translations of excerpts from this will, I think, better indicate the character of it than would any summary I could give of its contents. In introducing his subject the author writes:—

‘ Amongst the repeated experiments which have been made on the temperature of trees, those made by Boehm and Breitenlohner, which we are about to bring under consideration, deserve special attention.\*

‘ Krutzsch, professor in the Forest Institute of Tharand, published observations made by him during the years 1852 and 1853,† and Becquerel has published in a series of dissertations his experience, the principal object of which was to determine the thermometric or climatic influence of the forest.‡ In the meteorologico-forestal observations of Bavaria and Switzerland, the internal temperature of trees has also been the subject of observation; but up to this time there has only been published a *resumé* of the data obtained during the first years.§

‘ From these and other experiments, it appears that the periodical and irregular changes of temperature influence differently different parts of the tree, from the roots to the branches. The atmosphere and the soil are two factors

\* V. Band LXX. *Der Sitz. der K. Akad. d. Wissensch.*, I. Abth. Mai Heft.

† *Untersuchungen ueber die Temperatur der Baume*, etc., 1854.

‡ *Mémoires de L'Académie des Sciences*, 1861-64.

§ *Zeitschrift der Oesterreichischen Gesellschaft fuer Meteorologie*, Band IV.

which almost exclusively determine the temperature of the tree, both in its ærial and its subterranean parts. The influence of the temperature of the soil extends from the roots to the trunk, but only to a certain height, which is determined by the temperature of the air which surrounds the tree.

‘The temperature of the roots is imparted by the soil. The origin and nature of the soil and the subsoil, its mechanical and physical properties, the degree of humidity, the absence or presence of subterranean water, the superficial covering of the ground, and the varying degrees of sunshine and shade, are so many other factors which influence that by modifying the character and degree of temperature imparted to the roots. With change of temperature in the soil, which in most kinds of land are very slight even in the warm days of summer at a depth of one metre from the surface, the temperature of roots must change in the same proportion. The portion of these roots situated more than a metre in depth will only be affected by the heat of the ground throughout the year, which varies very little; while the roots at a less depth experience the daily changes of temperature in the superficial layers. A long, large, deeply-penetrating tap-root will produce in the warm months a diminution, and in the cold months an increase, in the temperature of the superior roots. Humidity exercises a very great influence on the thermometric conditions of the soil and roots. From this it may be inferred that the influence of the heat of the soil is not confined to the roots, but through the ascending sap makes itself to be felt to a certain height in the trunk. To determine by experiment this hypothesis, Hartig made some observations on two oaks of the same magnitude and same age, 200 years. At the height of a metre from the ground, he introduced thermometers to three different depths, and noted the thermometric condition of both trunks during the winter’s lethargy, as well as during the season of active vegetation.

‘The aerial parts of a tree are exposed to the direct

action of the temperature of the air, and to the occasional sunshine, so that the degree to which it is heated or cooled down, depends, when the conditions are the same, on the degree and duration of the sunshine or the shade. And in this respect the trees which are in a clump are differently affected from those which are isolated. The rapidity with which, other things being equal, the mass of a tree becomes warmed, depends on the surface and thickness of the bark, and on the conducting power of the roots and the wood in regard to heat. Wood in general is a bad conductor of heat, but all species are not alike in this respect. The influence of the specific heat of the bark and wood, as well as the chemico-physiological functions of the tree, however, we shall not here take into account.

‘ Differences in the size and diameter of the tree produce differences in its temperature. The daily oscillations and the maximum temperature of the trunk are so much the greater as the diameter of the trunk is less or as the point of examination is nearer to the surface. The thermometer shows a higher temperature in the branches than in the trunk ; and so much is it so as to show the temperature indicated by thermometers introduced into the trunk branch and branchlet to be in inverse proportion to the respective diameters of these.

‘ From this, then, it is deduced that the internal temperature of a tree takes a character related to and is produced by a great many circumstances having a reaction upon one another. It is therefore necessary, in order to similar observations being comparable together, that they should be made under identical conditions, and exact accordance in the location of the thermometers, in the height and depth of their position, the diameter of the trunk at the point at which the temperature is observed, and finally in the measure of sunshine or shade.

‘ All of these particulars serve as a basis to determine at three different heights the influence which the cooling effect of the roots and the crown of the tree exercises on

the temperature of the same. In experimenting, the cooling effects proceeding from the roots is produced by abundantly watering the ground; and that of the crown of the tree by suspended apparatus acting as a covering or shade. To ascertain with exactitude the cooling effect thus produced, it is required to have two trees, one of which may serve as a subject of experiment, and the other, under natural conditions, to serve as a tree for verification or comparison of results obtained.

‘To find two trees of the same species, development, girth, and height, and equally exposed to the action of light, presents some difficulty. Others also presented themselves to Boehm and Breitenlohner, arising from the necessity there was that there should be within a certain distance abundant water, and that the tree used for verification should not be so remote from the subject of experiment as to render impossible the comparison of conditions.

‘Two birches were chosen, which, however, did not fulfil all the conditions, as they were not in every respect exactly alike. The tree selected for experiments was in every respect weaker than the other which was to serve for comparison. In three different ways could be carried out the idea of placing thermometers, one at the foot of the tree, another half-way up the trunk, and the third in the branches—viz., first, placing them vertically equidistant without regard to the diameter of trunk or branches; second, without regard to equality of vertical distances, to seek for equal diameters; third, without regard to diameters, to place the thermometers at equal distances, and at equal depths in the trees. It was necessary to avoid a mixing of these three methods, in order not to complicate and confuse the observations.

‘Through the central layers of the birch constituting soft wood through which circulates the sap, it presents a possibility of placing the thermometer in the medulla of the tree. By adopting the first of the methods specified, the depth at which the thermometers would have been

placed in corresponding points in the two trees would have been very different; and by adopting the second, the distances of the points of observation would have been rather great, especially in the lower part of the trunk. The principal object to be attended to, was the determining the influence of the temperature of the soil on the thermometric condition of the trunk in relation with the ascending movement of the sap. Taking as a fundamental fact that the temperature of the soil influences the internal temperature of the trunk the more, the less distant the point is from the ground, and the younger are the wood circles, the experiments ought to be made at equal distances from the ground. In the first case, the temperature of the tree is intimately connected with the volume of the trunk or branches, and with variations in the thermometric conditions of the air. And the effects of temperature of this and of the sunshine propagate themselves transversely, while the temperature of the ground is propagated from below upwards. The direct comparison of the temperatures of the trees in the first two cases being excluded, this determined the naturalists Boehm and Breitenlohner to adopt the third method possible, that is, equal heights and equal depths. The two birch trees selected presented the following measurements:—

Horizontal distance between the two trees,	.	.	55 metres.
Height of birch experimented on,	.	.	15·5 „
Height of birch of verification or comparison,	.	.	12 „
Distance of lowest point of observation from ground,	.	.	6·3 „
Distance of middle point from lowest,	.	.	6 „
Distance of highest point from middle one,	.	.	6 „

# DIMENSIONS IN CENTIMETRES OF THE TRUNKS AT THE POINTS OF OBSERVATION.

POINT OF OBSERVATION.	TRUNK SUBJECT OF EXPERIMENT.				TRUNK SELECTED FOR COMPARISON.				
	Radius of Trunk.	Depth of Thermometer.	Distance from Medium Point.	Difference in Radius.	Radius of Trunk.	Depth of Thermometer.	Distance from Medium Point.	Difference in Radius.	Excess of Diameter of Test Tree over that experimented on
Lower,	18.75	15	3.75	...	21.75	15	6.75	...	6.
Middle,	11.75	10	1.75	7.	15.50	10	5.50	6.25	7.5
Higher,	7.	5	2.	4.75	10.	5	5.	5.50	6.
Difference between Higher and Lower, }	11.75	...	...	...	11.75	...	...	...	...

## GENERAL PROGRESS OF TEMPERATURE IN THE TWO TREES.

POINTS.	EXPERIMENT TREE.				COMPARISON TREE.					
	Commencement in Hours of		Duration in Hours of		Commencement in Hours of		Duration in Hours of		Time during which the Tree was colder than the Atmosphere.	
	Maximum.	Minimum.	Diminution.	Augmentation.	Maximum.	Minimum.	Diminution.	Augmentation.	During the Number of Hours.	Number of Hours.
Lower	2*	12	10	14	3	13	10	14	9 to 19	10
Middle	20	9	13	11	2	10	13	11	8 to 18	10
Higher	18	7	13	11	19	8	13	11	8 to 17	9

\* 24 hours being reckoned from midnight.

OBSERVATIONS.—The extremes were an hour later in the tree of comparison than in the tree of experiment.

The tables on the preceding page are tabulated results obtained, omitting remarks made on each, and on many of the details of each.

Temperature [probably Centigrade] of the air around the trees. Averages of fifteen daily observations from 21st August to 10th September:—

	Lowest.	Middle.	Highest Point.	Averages.
Experiment Tree, . . .	18·30	18·58	18·49	18·46
Comparison „ . . .	18·30	18·50	18·38	18·39
Difference „ . . .		0·08	0·11	0·07

Temperature of the trees from 21st August to 10th September. Average of fifteen daily observations:—

	Lowest.	Middle.	Highest Point.
Experiment Tree, . . .	16·68	16·83	17·57
Comparison „ . . .	17·03	16·88	17·13
Difference „ . . .	+0·35	+0·05	-0·44

Thermometric difference between the air and the tree:—

	Lowest.	Middle.	Highest Point.
Experiment Tree, . . .	-1·62	-1·72	-0·92
Comparison „ . . .	-1·27	-1·62	-1·25

In a comparison of the two trees, it is seen that the comparison birch is in its lower part as much hotter, as in its upper part it is as much cooler than the tree which was the subject of experiment. The higher temperature of the lower part of the former is attributable to the greater accumulation of heat in its greater volume; and on the other hand, that in the upper part is smaller through the greater diameter retarding the occurrence of the extremes.'

There has been published also by Senor Alvarez another paper entitled *Transpiracion de las Plantas*—Transpiration of Plants—a paper based on the works of M. J. Dufour, and on a memoir, *Ueber das steigen des Transpiracion stromes bei holzplanzen*, published in the *Arbeiten des Botanischen Instituts in Wurzburg III. Heft I.*; and another entitled *Formacion de los Nitratos en las Plantas*.

It may be long before Botany takes a place among the so-called exact sciences, but much was done to impart to the studies prosecuted under the designation of Applied Botany somewhat of the character of these. In 1877 there was published by El Illmo. Senor D. Maximo Laguna, one of the fathers of the School of Forestry, of whom mention has been made, an inaugural discourse, delivered by him before the Royal Academy of Science in Madrid—*Discurso leído ante la Real Academia de Ciencias Exactas, Físicas, y Naturales, por El Ilmo. Senor D. Maximo Laguna, en su Recepcion Publica.*

Some years since, by Royal order, a commission was given to this distinguished naturalist, as Inspector-General of of the Corps of Forest Engineers, and others to be associated with him, to prepare a report of the forest flora of Spain. In 1883 the first part of their report was printed at the expense of the Government. It comprises a description of the trees, shrubs, and bushes, indigenous or naturalized, in Spain, with short notes and observations on the culture and economic uses of the more important. There are given the most generally-used systematic names; the popular names; references to plates besides those accompanying the report which have been examined; a detailed description of each plant; the areas throughout which they are found; the locality in Spain in which each is found; conditions of the locality in which it flourishes; and brief remarks on its culture and exploitation. And it was intimated that probably there would afterwards be issued as an appendix to this work, a description of the trees and shrubs most frequently cultivated in Spain; but that this would be strictly a flora, and not a treatise on sylviculture, nor on exploitation or forest management; there would be given, however, some indications of the products and the culture of the more important.

In the following year there were issued, at the expense of the Government, 1000 copies of 38 plates, executed in chromo-lithograph, illustrative of the first part of the report of the commission. Every precaution necessary was taken



to secure a perfect re-production of the drawings which had been prepared ; and the work has been beautifully executed, representing the leafage, flowers, and fruit, with the organs delicately drawn and exquisitely coloured, having been completed under the charge of Senor Don Justo de Salinas, by whom the drawings were prepared.

While this work was in progress, there was published by Sr. Laguna a pamphlet, entitled *Coníferas y Amentáceas Españolas*—Spanish Coniferæ and Amentaceæ. In the preface to this he intimates that the Forest-Flora Commission had presented to the Minister of State a report in manuscript, illustrated by drawings, of their work in regard to conifers and amentuaceæ, in which details were given of some species of special interest to forest engineers engaged in silviculture ; but not knowing what time might elapse ere this should be published, he considered it might be of use to some meanwhile in classifying species belonging to these groups, the principal ones of Spanish trees, to have this key, which was arranged dichotomously. The portion relating to Conifers had been published in 1874 in the *Revista Forestal, Economica y Agricola*, vol. VII., and with some corrections and additions made to it it was added now to a like key to the Amentaceæ

In 1870 and in 1872 had been published *Résumés*, the former of the work done by the Commission in the years 1867 and 1868 ; the latter of this done in the years 1869 and 1870.

In 1880 there was published by the same author, a paper read at a Conference on Agriculture, held in the Conservatorio de Artes in Madrid on the 11th April in that year, entitled *Plantas Cryptogamas, su importancia en la Agricultura*—Cryptogamic plants, and the importance of them in connection with agriculture. In the following year was published by him another monograph, *Un Mesto Italiano y varios Mestos Españolas*—An Italian Oak, and sundry Spanish Oaks ; and in 1884 a paper entitled *Caracteres*

*de la Flora Espannola*—Characters of the Spanish Flora. A paper read at a Conference held in the Athenæum, Madrid, on the 11th March in that year.

And in the *Revista de Montes*, or Forestry Review, for January, 1881, appeared the first of a series of papers by him on Cypress—like plants, their habits and their homes.

Thus has been made, and is being made, provision for aid in the prosecution by students in the School of Forestry, of the studies in Applied Botany.

Of the ferns from the Philippine Islands in the Museum, there is a descriptive catalogue by Senor Laguna; and by the same author a description of an oak found only in these Islands. There is a memoir on the productions of the forests of the Philippine Islands, by Senor D. Ramon Jordana y Morera, Chief of the first-class of the Corps of Forest Engineers; and in 1885 was published a large volume by the same author, *Bosquetjo Geografico e Historico-Natural des Archipelago Filipino*—A Geographical and Natural History Sketch of the Philippine Archepelago—with additional notices of the productions of the forests, of which for many years he had been inspector; and a systematically arranged catalogue of the lignous forest and cultivated plants, collected in the forests of Manilla by Forest Engineer D. Sebastian Vidal y Soler, with notices of localities in which each had been found—a work of merit; and thus are the students supplied with works of reference in regard to all the forest products of the Philippines stored in the museum of the school.

#### *Sub-Section 4.—Sylviculture.*

Sylviculture on the Continent corresponds to arboriculture in Britain. The difference is mainly this: the former regards the wood or forest as the object with which it has to deal; the latter looks to the trees individually, whether growing solitary or in a mass of greater or less extent, as the subject of its consideration. There is more in this difference than may at first be supposed; but it may be

that the difference in the treatment of woods and forests in the countries in which these terms respectively are used, is in a great measure the result or consequence of the new departure taken by forest economy within the present century; and many of the treatises on subjects connected with sylviculture, published in Spain, are not greatly dissimilar to works which have been published in Britain on arboriculture.

In 1842 there was published by D. Pablo Bentelou, Director of the Royal Gardens of Alcazar, *Memoriæ, &c.*, a Memoir on the Acclimatisation of Foreign Plants, treating of climatic transplantation and acclimatisation; with a list of foreign plants suitable, in the opinion of the author for introduction into Spain, stating their *habitat* and properties.

In 1845 was published D. Josè Maria Pamãgua, Professor Emeritus of Agriculture, and member of several scientific societies, *Manuel del Podador, &c.*—The Pruner's Manual, or directions for the treatment of forest trees, in forests, woods, or plantations—in which physiological phenomena, the knowledge of which is necessary to the intelligent practice of pruning, are detailed; and the operation is described in its application in different ways, and to a great many different kinds of trees—being a compilation from various French authors, and instruments employed; with notices of the appropriate seasons of the year for such operations.

In 1844 was published in Madrid *El Arbolista Practico*, treating of the art of cultivating all kinds of trees; of the preparation and division of each; of the multiplication of them; of diseases from which they suffer; and of insects injurious to them; with a description of all kinds of forest and garden trees; the culture which each requires; its properties and uses. It is a manual, one of a series published about that time, under the collective title of *Agricultura Popular*. The directions are compiled from the most distinguished writers of the day.

In 1862 was published a work entitled *Calendario del Agricultor and Ganadero Para, 1862, &c.*—Almanack of Agriculture and Pastoral Husbandry—by D. Domiuga de la Vega y Ortis, illustrated by 17 engravings, and a beautiful agricultural map of Spain and Portugal. It contains, amongst other things, an article entitled *Arboles de Ribera*—Trees of the Coast—divided into three parts, which treat of the importance and usefulness of these; of the storing of the water, and the amelioration of the climate; and of the utilisation and equalisation throughout the year of the flow of rivers and running streams. And in all, much is said of the utility of extending the woodlands as a means of increasing the salubrity of the country, or diminishing the duration, frequency, and intensity of droughts: of ensuring the perennial flow of rivers by increasing lignous productions, and by other appliances of importance; and information is elsewhere supplied in regard to the proper treatment of timber. The article of which mention has been made was re-produced in the *Gaceta de Madrid* of the 29th October, of the year of its publication, 1862.

In 1863 was published a volume entitled *Manual de Selvicultura Practico*, or a Manual for the forester, the gardener the proprietor; and the forest warder, by D. José Garcia Sanz. It treats of sowing, planting, pruning, and all that concerns the cultivation of various kinds of forest trees; the collecting of their seeds, the diseases from which they suffer, &c. And in the following year another, entitled *Manual del Agricultor Asturiano*, by D. Luis Guez, of the Faculty of Science, Professor of Natural History, and member of the Patriotic Economical Society of Oviedo. It treats of the cultivation of the beech, the oak, the chesnut, the walnut, the pine, the ash tree, and others.

In the same year, 1864, was published *Arboricultura o sea Cultivo de Arboles y Arbustos*—a large work, in two volumes 8vo, with numerous plates. They were lectures delivered at the Scientific and Literary Athenæum of Madrid, by D. Antonio Blanco Fernandez, Professor in the Institution,

Doctor in Medicine and Surgery, Professor of Special Cultures in the Central High School of Agricultural Engineers, and member of various scientific societies at home and abroad. It treats of the organs, the physiology, the influence of atmospheric agencies, and the longevity and death of trees; it enters then on the consideration of all that relates to the culture of trees, and to the greatest possible extension of woodlands, with a view to aiding in which there is given a monograph on the culture required by each species; with notices of what is required in this in gardens, in pasture lands, in the open country, in parks, &c.; and the work concludes with observations on the utilisation and profitable exploitation of woodlands; and a recapitulation of the Spanish forestal legislation, which might affect or interest proprietors. The author states that he has throughout these lectures made use of the doctrines advanced in the work on the same subject by M. Du Breuil.

In 1874 was published in Tarragona, under the leading title of *Estudios Forestales*—two volumes by D. H. Ruis Amado, Forest Engineer, treating of the forests in their relation to the necessities of the village population. The author held the rank of Forest Engineer-in-Chief of the first class. In this are discussed numerous matters pertaining to forestry. The work was held in high estimation, as was also the author, to whom was awarded a gold medal for its publication.

Interested as the authors of these several works were as professional men, in the professional work to which they were more immediately called, they saw, as enlightened patriots, that by them, if not also by all who engaged in a similar calling, the importance of replenishing divested forests, and creating an extension of the woodlands of the country, was being realised, as it had not yet been realised, by the mass of their countrymen.

## SECTION 4.—STUDIES OF FOURTH YEAR.

In the fourth year of the student's curriculum, he is required to give attention to xilometry ; forest *ordenacion*, or forest partition and systematic exploitation on scientific principles ; forest industries ; the administration of law ; and political economy.

Sylviculture, to which attention is given in the third year of the course of study, and xilometry and forest *ordenacion*, to which attention is given in the fourth year of that curriculum, all relate to the modern scientific exploitation of forests, which, devised and developed by Hartig and Cotta in Saxony, in the beginning of the present century, has been introduced into Spain as into the other countries on the Continent of Europe, giving a character to the whole course of procedure in regard to forests, and the training of forest officials for the management of these.

*Sub-Section 1.—Xilometry and Forest Ordenacion.*

Xilometry comprises all that relates to the measuring of wood, and the principles involved in the application of this to trunks, boughs, and branches of growing trees, in order to enable the administrator of a forest to ascertain what cubic increase is being made by growth in each year, or decade, in the trees of a forest under his administration—that he may proportion to this the quantity of timber or firewood which may be taken from different compartments in it, it may be in different stages of growth and with varying degrees of vegetative vitality, with a view to insuring sustained productiveness. *Ordenacion* relates to the partitioning of the forest into compartments ; with a view to successive thinnings of different extent, culminating in a final felling, which will leave only the trees reserved for seeding to ensure the natural re-production of the forest. And Sylviculture relates to the culture of seedlings, saplings,

poles, and perches; the production of these by self-sown seeds; and artificial sowings or plantings required in the extension or creation of forests, or the replenishing of any which have become to a greater or less extent devastated, and of spots in self-sown re-produced forests, which from any cause may not have been covered with seedlings like the ground around; and to the treatment of the whole, till the cycle or revolution of re-production and felling has been completed.

In the conservation, culture, and exploitation, or profitable disposal, of forest products, considerable differences of practice exist. In Britain we hear much of game-keepers; on the Continent of Europe we hear much of forest-warders; here the game, there the wood, is the object of conservation. In Britain we hear much of arboriculture; on the Continent we hear much of silviculture: the former term I have told refers to woods and plantations, the other term to woods and forests; in the one case the unit is the tree, and the wood is considered as the collection of trees; in the other the wood is the unit, and the trees are considered only as its constituent parts. In the former, attention is given primarily to the sowing and planting, and pruning it may be, and general culture of the tree: nowhere, perhaps, has this arboriculture been carried nearer to perfection than it has been in Britain; and the effects produced by the resulting woods are wonderful. In the latter, attention is given primarily to the wood or forest as a whole, capable of yielding products which can be profitably utilized; and the result generally is to produce a much greater proportion of fine trees than does even the arboriculture which has been referred to. And not less different is the exploitation of woods in Britain and on the Continent. In Britain the pecuniary returns obtained from woods is considered a secondary matter in comparison with the amenity and shelter which they afford; but on the Continent the material or pecuniary product is made the object of primary importance.

The arboriculture of Britain may seem to leave little to be desired; but nowhere, perhaps, are forests treated with greater recklessness than they have been in some of our colonies and dependencies. In India, however, and in some of our colonies, an endeavour is now being made to arrest the destructive practices which have prevailed, and to introduce a system of treatment of forests more in accordance with the advanced forest science of the day.

In the United States of America, and in Canada, there have been effected extensive clearings of forest lands, resulting in injurious effects upon the climate, and in a greatly diminished supply of timber, with no prospect of this being compensated by the subsequent growth of trees in the localities. And in some of our colonies extensive forests have been treated like beds of onions, leeks, cabbages, and turnips, in the kitchen garden. Trees deemed suitable for some purpose desired have been felled, others around them have been left standing, or have been cut down to allow of the felled timber being brought out; and the results have been scarcely less destructive than the forest clearings elsewhere. These results may be seen in what were once forest-lands in the colony of the Cape of Good Hope.

More than 200 years ago France was in danger of being entirely devastated by this system of *jardinage* in the exploitation of forests, and in 1669 there was issued an ordinance—which soon became extensively famous, and is famous still—requiring the forests to be divided into a specified number of sections, one only of which should be exploited at a time, so as to allow time for the trees to be reproduced in each before all the others had been exploited in succession. The measure was not new, but was one likely, where adopted, to save not only France, but also other countries in Europe from devastation. Less than 150 years sufficed to show that this was a vain hope, for the reproduced forests were not equal to those which had been felled. And early in the present century there was devised, in Saxony, a more complicated,



but a much more efficient method of exploitation, which is being adopted everywhere on the Continent of Europe. It has been introduced with most satisfactory results into the management of forests in India; and the adoption of it seems to be the only means available to prevent the ruin of forests in our colonies, which are now being rapidly destroyed.

In this also the forest is divided into a number of sections corresponding to the time required for the reproduction of the trees. But instead of exploitation being confined to one of these at a time, the supply of wood required is obtained from the felling of the trees in one or more lots, and from first, second, and third thinnings in others—all being so arranged as to secure simultaneously, and without prejudice to one or other of them, an improved condition of the forest, a sustained supply of products, and a natural reproduction of the felled forests by self-sown seed. And all these results are now being obtained by this method of exploitation. This may seem to be the *ne plus ultra* of forest management. But in its application to any forest the arrangement of details must be based on the knowledge of a number—of a great number—of facts in regard to that forest, and an *ordenacion* or arrangement of sections and divisions of the forest founded on these.

There was published in 1847 a *resumé* of a treatise on forest taxation by M. Noirot-Bonnet, which had been published in France. It is a brochure of 129 pages quarto, entitled *Manual de la Tasacion de montes y bosquet, por Don José Maria Aniguá*. It comprises eight chapters, under which respectively the author treats of:—1. The taxation of woods, with different tables for use in the valuation of them under different aspects. 2. Tables of cubic measurement. 3. The increase in cubic measurement of trees. 4. The taxation of different species, with regard to various systems of exploitations. 5. Of the general possible production relatively to area and volume. 6. The comparative quantity of material products. 7. The pecuniary return obtainable by these. 8. The produce, brought under exploitation by thinnings and successive fellings.

From the use made in English of the word tax, and its derivatives, which in popular discourse, if not also in scientific discussions, are applied to what is exacted by the State directly or indirectly from members of the community, some difficulty may be experienced in receiving it as it is used in connection with forest economy on the Continent, in which the term taxation is applied to the determination of what produce a forest may yield, without injury to itself and with advantage to all concerned. Taxation, or the determination of this is a necessary operation in the profitable and scientific exploitation of a forest. It follows the survey and preparation of an inventory, and the presentation of a report on the conditions as to the growth and the vigour of vegetation of a forest. It has for its object to ascertain the quantity of wood material contained in a separate portion, or in an entire wood, and to determine the laws of its increase.

By Professor D. Francisco de P. Arrillega, member of the Corps of Forest Engineers, and Professor in the School of Forestry, it was seen that to facilitate important studies there was required a text book of formulas and tables required in the valuation of forests. Such a work was published by Dr. Gustav Heyer, Director of the School of Forestry in Munden, a man deservedly held in high estimation throughout Germany, and amongst students of forest science in other lands. This Senor Arrillaga translated into Spanish, and in 1872 it was printed by the Government at the National Press, under the title *Compendio de Valoracion de Montes*. According to the definition of Dr. Heyer the valuation of forests is that department of *Dasocracia* or forest economy, which has for its object the determination of:—1. The value of the ground by itself. 2. The value of the entire vegetable covering of this. 3. The value of the forest trees, and arborescent productions. 4. The annual rent or revenue of the ground, of the vegetable covering, and of the forest. The designation forest being now applied to the ground, and the vegetable covering and the trees growing upon it conjointly. And in

his work he treats:—1. Of general principles comprising the knowledge of the mathematical, economic, and forestal principles affecting the determination of the value of forests; and thereafter of the special application of these to the valuation of a forest. Under the first of these heads he discusses in successive chapters—1. The subject of value, distinguishing between price and intrinsic value. 2. The idea of interest, discussing differences existing in the amount of interest in general; differences affecting forestal interest in particular; and the determination of interest in relation to forest property. 3. The calculation of interest according to a critical determination of the kind of interest, simple, compound, or combined, which should be selected in the capitalisation of revenue or rent; a critical determination of simple interest of compound interest; and of a combination of these. 4. Formulæ for the calculation of interest, according to necessary modifications of compound interest, with tables of factors to be made use of in such calculations. 5. Income and expenditure.

Under the head of special application of the general principles to the valuation of a particular forest, he discusses in successive chapters:—1. The determination of the value of the ground by its abstract value, its cost, and the price which would be obtained by sale, with a statement of some general considerations affecting the abstract value, and a critical determination or decision relative to the employment of this in determining the value of a forest. 2. The determination of the value of the vegetable covering according as this may relate to the whole plot, or to isolated trees, or to a specified portion of the lot, discussing in regard to the first mentioned case the determination of the abstract value of this, and conditions which may effect this advantageously or otherwise; the determination of it by the cost, and general conditions on which the amount of this depends; and the determination of it by the price which would be realised by sale. Thereafter are discussed the

valuation of the increase by growth of the vegetable covering in one or more years; and the valuation of the vegetable covering of a whole forest, in the condition of a formal series of compartments in successive stages of growth, and preparation for thinning and felling. 3. Valuation of a forest, comprising both ground and crop by its abstract value, its cost, and the price it would bring if sold—viz., with a valuation of its returns or rent. 4. Determination of forest returns or rent—that of the ground; that of the crop; and that of the forest comprising both. And there are appended tables for the calculation of interest on the bases of different factors. .

In 1880 was published a volume entitled *Elementos de Tasacion Forestal por el Ingeniero Cav. Francisco Piccioli, Director de la Real Escuela de Montes de Valambrosa Traducidos del Italiano por R. Alvarez Seriox Alumno de la Escuela Especial de Ingenieros de Montes*, Elements of Forestal Taxation by the Cavalier Francisco Piccioli, Forest Engineer and Director of the Royal School of Forestry at Vallambrosa, translated from the Italian by R. Alvarez Seriox, élève of the School of Forest Engineers, Alumnus.

The two parts of this work by Cav. Piccioli, remarks Senor Alvarez, though intimately connected are yet severally complete, and both manifest similarly excellencies of lucidity in arrangement, and a free style in strictest harmony with mathematical precision. In the flowing language of Ariosto, and others of his country's literary men, he describes the implements, and the mode of using them in collecting the data required, and the application afterwards made of the data obtained.

The *Taxation* relates to the determination of the material at the command of the engineer; the *Assessment* has to do with the determination of what may be utilised. As stated, it is the first part only of the Cavalier Piccioli's work which is brought under consideration. The fundamental data required for taxation are measurements of the trees, of each and all, or of a number of them so selected as to

suffice the operator in ascertaining, with proximate accuracy, such average measurements as will afford satisfactory data for estimating the measurements of the remainder.

In the work under consideration the first chapter is devoted to a description of the structure and application of dendrometric instruments; and under successive headings are described:—1. Instruments for the measurement of circumferences and diameters. 2. Means of determining heights of trees. 3. Various dendrometers. 4. Trigonometrical measurements of heights and diameters. 5. Instruments for measuring the increase made by growth. 6. Instruments employed in the measuring of timber, and in determining the power of resistance and density of woods.

The second chapter relates to instruments employed in determining the measurements and the increase by growth of single trees; and under successive headings are described:—1. The typical measurements made. 2. The determination of the cubic measurement of single bolls. 3. The determination of the cubic measurement of a standing tree. 4. The determination of the cubic measurements of stump, branches, and bark. 5. The determination of the increase made by growth.

The third chapter is occupied with discussions relative to trees, and the increase made by them in woods. Under successive headings are discussed:—1. The density of the growth of trees in a forest, and corresponding classifications of them on this ground. 2. The determination of the number of trees in a forest by different methods—enumeration and otherwise; the formation of classes, according to height and bulk; the selection of the number of typical trees for each class, concluding with observations and formulas relative to the selection of type trees. 3. The increase made by growth, and the determination of periods in which this varies by increase or diminution. 4. The construction of tables, including the calculation of co-efficients, and methods of

determining approximately the increase made. 5. The determination of the produce of clearings.

In 1883 there was published a valuable exhaustive treatise on the scientific classification, arrangement, and exploitation of forests, entitled *Ordenacion y Valoracion de Montes*, by D Lucas de Olabazal, of the Corps of Forest Engineers. In this are embodied and assimilated the instructions given otherwise in regard to the mensuration of trees, to the determination, by estimate or otherwise, of the cubic measurement of the contents of a clump of trees, a wood, a compartment, or a forest; to the determination of what increase by growth is being made, or which is expected to be made; and to the valuation of forests and forest lands: the whole being subordinated to the purpose for which these data are required—the management and exploitation of forests in accordance with the advanced forest science of the day. In doing this the author defines a forest as ground of considerable extent covered with woods of spontaneous growth or artificial planting, maintained specially with a view to obtaining timber or wood, or with a view to prevent damages being done by denudation. He recognises the difference between what he designates herbaceous forests, and timber forests and coppice-woods.

In the first part of his work, in which he treats of data required as preliminaries to *Ordenacion*, he specifies amongst these an inventory or special report in regard to the legal condition of the forest, in regard to the administration of it, and in regard to rights of servitude upon it; its boundaries; its natural conditions in relation to position; the character of the ground as to composition and superficial contour; and its forestal condition in numerous particulars. Amongst others these: details in regard to the general plan of the forest; the outline, position, contents, and general conditions of the different clumps, woods, or compartments, and the relative value of the characteristics of each of these; with details of a complete and of a

partitional survey; and a plan or chart of each compartment. The author details then all information embraced in the studies of the school in xilometry: both that relating to the cubic measurement of the wood, and that measurement in regard to all the trees on the ground; and all the information embraced in the studies of the school in regard to increase made by growth. He then treats of secondary products, and of intrinsic conditions of the forest.

Treating in the second part of *Ordenacion* strictly so-called, he specifies as preliminaries to be determined the formation of circuits; the kind of trees to be grown; the exploitation to be followed—timber forest, coppice, or a combination of the two—and the number of years to be preferred as constituting the revolution or cycle of growth and reproduction. Next, under the head of *Methodes de Ordenacion*, there are detailed the different methods of division of forests in use—that according to equal areas, or the French *Methodes a tire et aire*; that inversely proportional to the condition of the crop; areas inversely proportional to the actual produce; and what he calls the indirect division. There are next discussed the methods of division followed in Spain; and there is given in detail, with illustrative chart, the plan of *Ordenacion* adopted in the forest '*La Herreria*.' There are then passed in review the methods of distribution proposed by Bekman, Osteltt, Schilcher, Hennert, Wedel, J. L. Hartig, and E. Cotta. There are next discussed what are designated the rational methods of exploitation, summarised as:—1. Methods based on average increase. 2. Methods based on the Austrian rates. And 3. The harmonic methods. Under the head of Austrian rates, a development of that of Hartig and Cotta, he passes in review the views of Huber, advanced in 1812, and those of Hundeshagen.

Proceeding then to the subject of exploitation the author discusses in succession the preparation of a general plan of operations; the preparation of a special plan for each compartment; and the successive revisions to which this should be submitted as exploitation advances, and new

data are obtained—all in accordance with what is generally done in other countries in which the forests are thus managed. There follows a chapter on the *ordenacion* of irregular timber forests; and thereafter discussions of the theory and practice followed in the valuation of forests, with detailed cases in illustration of the satisfactory consolidation of lordship or tenure and territory, in disputed cases involving difficulties.

### SECTION 5.—FOREST INDUSTRIES.

Under the head of Forest Industries, information is supplied to the students in regard to all that is being done in Spain with forest products to prepare them for the market and for use. It includes the cutting up, if not the felling of timber, excepting in so far as the manner of doing this may affect the use to be made of it; the preparation of fuel yielded by the forest, whether as firewood or as charcoal; the collecting and preparation of bark, and in connection therewith the preparation of cork; the collecting and manipulation of resin; the collecting and disposal of esparto grass; and much besides.

Of the comprehensive character of the instruction given under this head, and the provision made to fit forest engineers for the efficient discharge of duties to which they may be called to give their attention, in connection with the profitable disposal of forest production, an illustration is supplied by a volume entitled *Industria Forestal-Agricola*, published by the illustrious Senor D. Salvador Ceron, Chief of the First Class in the Corps of Forest Engineers, superior Honorary Chief of the Civil Administration, and Knight-Commander of the Royal Orders of Charles III. and of Isabel la Catholic, &c., in which information is supplied in regard to well-nigh a hundred materials and products and processes of forest industry.

In the catalogue of articles of forest produce sent to the Agricultural Exhibition, held in Madrid in 1867, there appear round timber, cut timber, charcoal, resin, bark, &c.



*Sub-Section 1.—Preparation of Timber, Firewood, and Charcoal.*

In 1877 there was published by Senor D. Eugénio Pla y Rave, *Marcos de Maderas, &c.*, or Felled Timber for use in Civil and Naval Structures, with the prices obtained for them, and other forest products in the different provinces of Spain.

After classifying the timber referred to as timber used in shipbuilding, in architecture and engineering, in carpentry and cabinet-making, and as round logs, logs partially squared, square logs, and sawn timber—and stating what kinds of timber yielded by the forests of Spain are used for the different purposes, and sold in the different forms spoken of, and conditions determining different sizes, and prices of these, he proceeds to give tabulated statements of the linear and cubic measurement of different kinds, the unit of measurement by which each was then sold, and the prices obtained in the different provinces in Spain, in Cuba, in Porto Rica, and the Philippine Islands; also, tariffs settled by Government for direction in the purchase of timber in the arsenals and other public workshops in the kingdom; and in an appendix tabulated statements of corresponding longitudinal and specifical measurements, weights, measures of capacity, liquid and dry, and designations of quantity used in sales of firewood in the different countries of Europe.

And in the *Revista de Montes*, or Forestry Review, of November, 1879, is given the first of a series of papers on the specific gravity and density of woods of different kinds.

For firewood there is in Spain nothing like the demand which there is in Central and Northern Europe. The climate is different, and I saw there no such extensive preparation and storage of this as I had seen elsewhere. For domestic purposes there seemed to be used exclusively small wood, such as might be yielded by branches and brushwood, and charcoal seemed to me to be used by all who could afford to make the purchase of this.

Information in regard to the preparation of charcoal, and in some cases in regard to the collecting and utilising of products, resulting from the distillation of wood, is supplied by Senor Ceron ; and in 1885 there was published by D. Carlos Castel y Clemente, member of the Corps of Forest Engineers, a volume entitled *Combustibles Vegetales: Teoria y Practica de la Combustion, Carbonizacion, y Destilacion de la Madera*, or wood. For some years it had been felt as a great desideratum in the class of Forestal Industriy in the School of Forestry, a treatise on this department of forest industry, which, being adapted to the existing conditions of forest production in Spain, and to the possible development of industries in which might be utilised more extensively the forest products of the country, might serve as a text-book for the students, and for any others who might give their attention to this branch of industry. The collection of data for the preparation of such a work was begun by the author, others communicated to him observations made by them ; and the production of this work was the result.

In successive chapters are discussed :—1. General ideas of combustion ; the combustible elements of wood ; and the theory of combustion. 2. Firewood, with a definition of firewood ; notices of the calorific power and phenomena of its combustion ; directions in regard to the felling of firewood, and the classification and sale of the material. 3. Charcoal ; the nomenclature and classification of different kinds ; horizontal and vertical furnaces ; qualities and produce of charcoal made in the open air ; relation between the wood burned and the charcoal obtained. 4. Charcoal and tar furnaces constructed for the preparation of tar ; carbonisation in these ; different structures employed. 5. Apparatus for distillation of wood, and process for the procuring of pyrolignous products ; apparatus and process employed in the separation of tar, methylene, and acetic acid ; apparatus and process for the preparation of illuminating gas from the distillation of wood. 6. Potash, mode of obtaining this, and process of purifying ash salts

obtained from wood. And in the appendix are discussed the origin and classification of peat or turf; the composition and analysis of this; the digging out of peat; the carbonisation of it, and the products of the distillation.

*Sub-Section 2.—Collection and Manipulation of Resin.*

Similar to pitch and tar in chemical composition are resin and turpentine. But these can be obtained from growing trees. In the work by Senor Ceron, which I have cited, information is given in regard to the collecting of the raw material, the manipulation of this, and uses to which the products are applied in Spain. This is an industry carried on largely in the plantations, of maritime pine, on the Landes of the Gironde.\* The abundant growth of this tree on the Peninsula is confined almost entirely to the western slopes of the west coast of Portugal.

The pine most abundant in Spain is the stone pine *Pinus Pinea*, there known as the *Pino Pinnonero*, the *Pino de la Tierra*, the *Pino Doncel*, the *Pino de Pinnon Comestible*; and it is found to be well adapted for profitable exploitation as a resin yielding tree. It abounds in the province of Cadiz, and Senor Ceron gives the account which follows of the exploitation and manipulation of its produce:—It is believed to be indigenous, and produced from seed; it covers extensive areas of sandy soil, and of lands called *Barros*—alluvial lands—in the lower lying and sub-mountainous regions of that province.

‘The resiniferous vessels are not so pronounced in this pine as they are in the *Pinus Pinaster*—the cluster pine—and in the *Pinus maritima*; and the body of the tree is not so impregnated with resin as are these. When the east wind prevails,† and the days are warm, the resin accumulates in great quantities in the incisions made in the

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\* Information in regard to these, and the exploitation of resin produced, I have given in a volume entitled *Pine Plantations on the Sand Wastes of France*.

† I presume the wind is designated from the direction whither it blows, contrary to British practice of designating the direction of winds by reference to whence they come.

trees; and the evaporation of the spirit of turpentine is so rapid that the resin solidifies, obstructing thus the flow of additional material. There have not as yet been made the experiments necessary to determine the maximum quantity of resin which the stone pine may yield.'

Senor Ceron having been urged repeatedly to undertake the direction of the resination in the pinery called *Villanueva* in the Province of Puerto-Real, undertook, but with some reluctance, the task, making 5000 pines of from 30 to 50 years of age the subject of experiment.

'In the latter half of March, 1872,' says he, 'they began to bleed the pines. From a decimetre above the ground, to the height of a metre, they cleared the bark of all asperities and roughnesses for a breadth of two centimetres. With a pitchworker's hatchet the first incision in the tree was made, cutting into the trunk from the lower edge of the cleared bark, with a breadth of 11 centimetres, a length of 2 decimetres, and a depth of 1 centimetre.

'To collect the resinous material there was followed the method of M. Hughes, there being used small vessels of clay, glazed inside, in the shape of a truncated cone—like a small flower pot—and about a quarter of a litre in size. At the bottom of the incision there were fixed some iron holdfasts, slightly bent, along which the resin might run, flowing without loss into the receivers. As the incisions are enlarged the receivers must be raised, which is done by their being suspended from a nail by a hole in their side.

'It may be observed that with this species of pine the receivers require to be renewed every third, or it may be in some cases every fourth day, this depending on the vegetative vigour of the tree and the state of the atmosphere. When, as is frequently the case in summer, the east wind prevails for some time, the evaporation of the spirit of turpentine, and the aqueous constituent with which the resin is combined, evaporate with great rapidity; the turpentine becomes solidified, and it is thus kept from

flowing into the receiver, and the resiniferous vessels of the tree become obstructed, the flow of the liquid is arrested. To meet this it is necessary to change the receivers every three days. When the wind is north-west and west the air is cooled, and the turpentine flows till the fourth day without any necessity to change the receivers.

‘It has also to be stated, that when the incision penetrates the sixth ring of the alburnum, there are thence obtained only slight indications of turpentine; that from the second and third layers are obtained the largest quantities; that from the first and fourth there flows less, and still less from the fifth. Amongst the trees chosen for observation those from 35 to 45 years of age yielded proportionately the greatest quantity of turpentine; and of these those which were growing with greatest vigour and luxuriance.

‘The collecting of resin was continued till the 15th of October, giving seven months of a resin harvest, or, as it is designated, *resination*. Collected conveniently in a receptacle prepared for the purpose, the whole quantity measured 7335 litres, which was equivalent to about 1.2 litre per tree. From this, when manipulated in manner and form to be afterwards detailed, there were obtained 368 litres, or 32 *arrobas*—the arroba is a weight of 25 pounds—of *boras*, or earth, impure resin, mixed with small fragments of chips, bark, &c., or 5 per cent of the material extracted and measured; 5369 litres, or 467 *arrobas*, of *colofonia* or resin, amounting to 78 per cent; and 1471 litres, or 128 *arrobas*, of spirits or essence of turpentine, equivalent to 20 per cent.; and 147 litres, or 12 *arrobas*, of water and other matters were lost by evaporation.

‘To determine the expense, and returns of the resination of these 5000 trees, it is only necessary to state the value of the products at the fabrique or manufactory on the pinery of Villanueva: 467 arrobas of colofonia at 11 reals\* = 5137 reals; 128 arrobas of *aquarras*, or spirits of turpen-

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\* The real is equal to 2½d.

tine, at 60 reals = 7680 reals; 5 arrobas of *breas*, tar resulting from the *borras* and impure resin, at 12 reals = 60 reals — in all, 12,877 reals.

‘The expenses were :—

420 days’ wages of the men, two in number, employed in collecting the resin, at 14 reals, -	-	5880 reals
210 days’ wages of a boy, assistant to them, -	-	1260 „
10 per cent. interest on the capital of 15,000 reals invested in the small fabrique and utensils employed, -	-	1500 „
10 per cent. on the sum of these for unforeseen incidental expenses and the direction of the work, -	-	864 „
		9504 reals

‘Deducting the expenses from the returns, there is a nett gain of 3373 reals, corresponding to a gain from each tree of 67 reals. With the problem thus solved, showing that it would be profitable and satisfactory to continue the resination of stone pines, the proprietor did not hesitate about submitting to this method of exploitation a greater number of trees.

‘In the year following he subjected 75,000 trees to this treatment, and judging from the quantity of turpentine obtained during the first month of operation, it may be supposed that the products, if not superior to those yielded in the experiments of the previous year, would have been approximately equal to them; but the political movements which were so accentuated in Cadiz and the province around, prevented the ascertaining in an indubitable manner of the entire production, as during a third part of the time of the resination the operations were stopped.

‘Let it be supposed, and it is no great concession, that the 75,000 trees yielded proportionately the same profits as were obtained from the exploitation of the former 5000, there would result a nett return of 50,574 reals.

‘In the year 1874 the resination was extended to 120,000 trees, but the work has been stopped in consequence of ruinous losses to which the proprietor of the state has been subjected through operations of a different kind, and the lamentable depression of trade which has come upon all our larger towns.

‘By the resination of pineries similar to those of Villanueva, there is in no way whatever affected the produce in pasture and fruit, the seeds being in demand as such ; and firewood, and small-kneed timber, made use of in the construction of small vessels and boats, being unaffected either in quantity or in pecuniary proceeds. Tortuous and crooked trees, and those from which resin is collected, when these have yielded all the turpentine obtainable from them, admit of easy and convenient application to such boat and ship-building ; and it should be known that the wood obtained from trees which have thus been bled, is better than those which have not so been treated, because from being saturated with turpentine, they decay or rot less readily and prove more lasting. The stumps, chips, and defective wood of trees, which cannot be used in carpentry, are appropriated for use in the manufacture of *alquitran*, pitch or tar.

‘To effect the resination and extract the product, the following implements are used :—1. A common hatchet. This is used to clear away any roughness or projections from the bark, and the place where the incision is made. 2. A pitchman’s hatchet. This instrument has a certain curvature in the handle, and is used to make the flat wounds in the tree, and renewals of these. 3. A ladder. When the cutting cannot be reached from the ground it is necessary to make use of a light hand-ladder, or a three-cornered pole or beam, with steps cut in it on two of the angles, that placed at an inclination against the tree it may enable the workman to reach the place on which he has to operate. 4. A rake ; formed like a pick-axe or hoe, provided with a handle a metre and half long, which serves for clearing the bark at heights which cannot be reached with the hatchet. 5. A resin rake. This implement is used to rake off resin in a concrete or solidified state from the cuttings ; it is composed of a short handle, and a curved blade of iron. 6. A shovel. This shovel is of iron, with a handle of wood, and serves principally for the removal of the resin to the bucket.

7. A pitchman's bucket. This bucket is similar to those in domestic use; it serves for the transport of resin to and from the receivers and the deposits. 8. Depots or receptacles for the resin. The depot depends in size on the magnitude of the fabrication, and care must be taken to prevent the absorption of the spirit or oil of turpentine. What gives the best results is to line it with Roman cement, and paint this with *pirogenado* oil; precautions must also be taken against fire.'

There follows detailed information regarding the various processes employed in the preparation of spirits of turpentine, resin, pitch, tar, and lamp-black; and of the various uses to which these, and preparations from them, are applied — with all of which it is considered desirable that the forest engineer should be acquainted, or in regard to which he should have at command the information which at any time may be required in the discharge of his functions. The volume by Senor Ceron was published in 1879.

In a paper on the resin trade of Valladolid, by Senor D. Felipe Romero Gilsanz, which appeared in the same year, the writer says:—'We do not undertake to describe the process of collecting the rough turpentine from the Maritime Pine, *Pinus Pinarte*, Sol., and the elaboration of this in the manufactory. Our purpose is more limited: it is to give a brief sketch of the resin trade in Valladolid, considered from an economic point of view; and in entering upon this we believe that the deductions which may be drawn will prove applicable to a great extent to that industry everywhere throughout the Peninsula.

'Some eight years ago it was proposed to collect the rough turpentine, or raw resin, from 20,000 pine trees, as a means of obtaining a new product from the public forests; and with a view to securing good results, attention was directed to what had been accomplished in this way in the district of Segovia. To the cutting of these pines succeeded the establishment of a resin manufactory within the bounds of the aforesaid town; and in the year 1874, by



Senors Don Theodora Elias Huard, and Don Julio Touchard, there were liberally assigned for this on the plan still practised, the great number of 118,000 pines, of which 94,000 are now in course of being exploited, and the rest are to be disposed of by auction.

‘Not only has a beginning thus been made, but we find there is being utilised in this way 8 per cent. of the produce of the forests; and that thus has been promoted the better conservation of those which enjoy the constant watchful care of the guards in charge of the erections for the manufacture of the resin.

‘Assuming then, as a starting point, that there is obtained from each pine 3 kilogrammes of rough turpentine, which we do not consider to be at all an extravagant assumption, the annual product from the 94,000 trees mentioned will amount to 282 metrical tons; and a greater quantity than this might be procured, in as much as the possible yield of the forest would admit of this, if all the measures favourable to this new-born industry were taken; but as up to this time it has not been possible to get any extraneous impulse towards its development, we fear that the produce of the raw material will, on the contrary, be found gradually decreasing. This supposition is based on data, which in the sequel will be adduced, taken from the manufactory, of which the nephew of Don Julio Touchard has charge, which is distinguished alike for the skilful devotion under which it is conducted, and for the exactitude of its management and accounts.

‘Rate of cost of manufacture of 500 kilogrammes of resin in the manufactory in Valladolid:—

	<i>Pesetas*</i>	<i>Cent.</i>
Hire of Pine Trees, - - -	3	74
Labour of Collecting Raw Material, - - -	6	41
Packages and Packing, - - -	0	54
Transport to Manufactory, - - -	1	85
Sundry Incidental Expenses, - - -	0	58
Total per 100 Kilogrammes, - - -	13	12

\* The Peseta, as has already been stated, is equal in value to a franc, and like it is divided into centimes.

‘ Cost of making 100 kilogrammes of distilled resin :—

	<i>Pesetas.</i>	<i>Cent.</i>
Resin at Manufactory, - - -	13	— 12
Loss in Manufactory, - - -	2	— 60
Wages, - - -	1	— 50
Expense of Manufactory, - - -	0	— 80
Fuel, - - -	0	— 48
Packing of Material, - - -	0	— 32
Vessels, - - -	1	— 50
Total per 100 Kilogrammes, - - -	20	— 32

‘ The products obtained in the distillation of 100 kilogrammes are according to the following scale :—

	<i>Kilogrammes.</i>
Spirits of Turpentine, - - -	17
Colofonia (Resin) No. 1, - - -	16
„ „ No. 2, - - -	30
„ „ No. 3, - - -	18
Pitch, - - -	7
Residue and Loss, - - -	12
Total, - - -	100 Kilo.

‘ Bearing in mind the cost of 13·12 *pesetas*, at which 100 kilogrammes of resin is brought to the manufactory, which, when distillation is completed, amounts to 20·32 *pesetas*, it will be easily calculated what the cost of these several products will be; and seen that the actual cost or price will be :—

	<i>Per 100 Kilo.</i>	<i>Pesetas</i>
Spirits of Turpentine, - - -	57·50	„
Resin, No. 1, - - -	18·75	„
„ No. 2, - - -	15-	„
„ No. 3, - - -	12·50	„
Pitch, - - -	10-	„

‘ What we have shown to be the expense of obtaining these products in the manufactory of Valladolid it may be presumed will, with slight differences, be the expense in the district of Segovia, at the manufactory of Coca, and supply the data required in judging of the resin trade; and may clear us of exaggeration in extending them to

the products obtained at the manufactory of Las Navas—the conditions under which they are obtained in the two provinces in which they are situated being similar to that of Avila; and we may feel ourselves at liberty to make use of these data in discussing the competency of our home products to compete in our markets with products imported from abroad. Adverting then to the proximity of France to Barcelona, the first market in Spain for this class of produce, we find in the following tabulated accounts the disadvantages under which the Spaniards labour:—

## SPIRITS OF TURPENTINE.

FRENCH PRODUCE.		<i>Pes. Cent.</i>
Actual cost in Dax,	- - - - -	44—0
Transport to Cette,	- - - - -	2—20
Transport from Cette to Barcelona,	- - - - -	1—70
Duty,	- - - - -	10—0
		<hr/>
Cost in Barcelona of 500 Kilogrammes,	- - - - -	57—90

## SPANISH PRODUCE.

SPANISH PRODUCE.		<i>Pes. Cent.</i>
Cost in Arevalo, Las Navas, or Valladolid,	- - - - -	57—50
Transport to Barcelona at Railway Rates,	- - - - -	7—75
		<hr/>
Cost in Barcelona of 500 Kilogrammes,	- - - - -	65—25

## COLOFONIA OR RESIN, No. 1.

## FRENCH PRODUCE.

FRENCH PRODUCE.		<i>Pes. Cent.</i>
Actual Cost in Dax,	- - - - -	14—50
Transport to Cette,	- - - - -	1—90
Transport from Cette to Barcelona,	- - - - -	1—70
Duty,	- - - - -	0—25
		<hr/>
Cost in Barcelona of 500 Kilogrammes,	- - - - -	18—35

## SPANISH PRODUCE.

SPANISH PRODUCE.		<i>Pes. Cent.</i>
Cost in Arevalo, Las Navas, or Valladolid,	- - - - -	18—75
Transport to Barcelona at Railway Rates,	- - - - -	6—75
		<hr/>
Cost in Barcelona of 500 Kilogrammes,	- - - - -	25—50

‘The relative cost of spirits of turpentine and of resin, No. 1, indicate the relative cost of the other products, and show that France can put them in the market in Barcelona six *pesetas* cheaper than we can. In Santander, and other ports of less importance, the effects of this competition are less manifest, the inequality not being so great as in Barcelona; and if, from the French products yielded by their renowned plantations, the Landes, we go to the products obtained on a great scale from American forests favoured by an exuberant vegetation, the Spanish products cannot successfully compete with these, since the expense of extraction and elaboration in America is much below what it is in Spain; and we have little to add to this for expense of transport, as vessels carry this class of products as ballast, at a very low charge for freight.

‘From what has been stated it is manifest that the resin trade cannot be said to be in a lively condition, or to contain germs of vitality, seeing that it cannot compete with imports from abroad, which can be put in the market paying 10 *pesetas* for 100 kilogrammes duty for spirits of turpentine, and 25 centimes duty for a like quantity of resin, No. 1. It seems then to be indisputably necessary to raise the duty, especially that on resin, which is almost *nil*; for so long as the duties are what they are at present it is easy to account for the great quantities of the latter products being stored in the manufactories, and the difficulty in effecting sales.

‘We do not consider that we are competent to discuss the graver question of general regulations, applicable to every case, which would require lengthened consideration and a clear judgment in regard to general utility; but what we think is that with a growing industry, as is the resin trade in our country, everything proper to increase it should be done, and so far as it presses, every difficulty should be taken out of its way, that it may compete freely with foreign products in the home market. Every industry labours under difficulty which has in its beginning to bear equal burdens with those which are already established,

in consequence of the natural obstacles which are always encountered in beginning anything new, notwithstanding that it requires, on the contrary, means to promote its development. This once secured, the new industry can, and should, bear its part in sustaining the burdens which fall necessarily upon a nation; but it is only thus, according to our judgment, that it can become useful, as by gathering the fruit too soon the tree which yields it may be destroyed, while otherwise it might have yielded crops continually and plentifully.

‘As the information solicited, by circulars dated 8th August last, should now be collected, we may presume that the Consulting Committee of Valuations and Regulations may now take up the question, and give a deliverance upon it. Granted the competence, and proper action of the persons comprising it, we may hope that they will be able to propose some measures to enable the resin industry to come out of its present lethargic condition; and we should greatly rejoice if these, and other forest industries of a similar character, should enter upon an era of progress and profit; and this would beyond all doubt redound to the increased pecuniary productiveness of our public forests.’

*Sub Section 3.—Collection and Manipulation of Bark and Cork.*

In connection with the collection of bark for tanning, there is supplied in the work of Senor Ceron information in regard to the quantity of tannic acid yielded by the bark of different kinds of trees; and in the same year in which it was then published was published a work by Don Carlos Castel, Professor in the School of Forestry, entitled *Estudios sobre el Tanino: Memoria premiada con el accesit, por la Real Academia de Ciencias Exactas, Fisicas y Naturales, en la Concurs Publico, para 1876, Sobre el tema determinar el valor intrinseco de la materias curtientes o astringentes, referido al del Tanino producido por los vegetales de Cinco o mas provincias de Espanna; y exponer con la aproximacion posible, in edad de los vegetales, de donde proceden su cultivo, habitacion y estacion, epocas*

*del anno mas favorables, para la recoleccion de los productos, y las vias o medios de exportarios o conducirios a los Mercados—* Studies in Tannin—a memoir for which a prize was awarded by the Royal Academy of Exact Physical and Natural Science, at the public meeting in 1876; a prize offered for a paper on the subject of the determination of the intrinsic value of the tanning, or astringent matter in the tannin produced by the vegetables of five or more provinces of Spain, with a statement as precise as possible of the conditions of the vegetables from which the tannin had been obtained, the culture to which the plants had been subjected, their *habitat*, the season of the year most favourable for the collecting of the products, and the ways and means of exportation and bringing these to market.

A more important industry in Spain in connection with bark is that of cork, yielded by the *Quercus Suber* which grows there abundantly; and on this subject also Senor Ceron supplies valuable information, nor is there any lack of special treatises on the subject.

In regard to the collecting and manipulation of cork-bark, there was printed for private distribution in 1876 a pamphlet, entitled *Elcornoque y la Industria Taponera, por Don Primitivo Artigas y Teixidor, Ingeniero de Montes, Profesor Interino y Ayudante de la Escuela Especial del Ramo—*The Cork Tree and Cork-Cutting Industry, by Don Primitivo Artigas y Teixidor, Forest Engineer, Interim Professor and Assistant in the School of Forestry. In this information is supplied in regard to the botanical character of the species; and to its different parts; the climatic and other physical conditions of its vigorous growth; the artificial production or replenishing of cork tree woods; the area of the growth of the tree; the exploitation adapted to it; the secondary products yielded by it; the enemies and diseases to which it is exposed; and the pecuniary returns yielded by the culture of it. In connection with the cork industry are detailed the preparation and manipulation of the sheets of bark; the manufactory and improvement of

corks ; and much relating to the commerce in corks and to other appliances to which the material is and may be put.

In 1879 there was published a work entitled *Le Chêne Liege en Algérie*, par M. A. Lamey, Inspecteur des Forests—The Cork Tree in Algeria, &c. Of this, in 1881, Senor D. Primitivo Artigas, now Chief in the Corps of Forest Engineers, and Professor of Sylviculture, Meteorology and Climatology, in the School of Forestry, published in the *Revista de Montes*, and afterwards reprinted a *Resena Critica* or Critical Review. And four years later, in 1885, he published as a reprint a pamphlet entitled *Alcornocales Industria Taponica*—The Cork Industry of the Cork-Oak—a part of a larger work reporting what had been made subjects of observation on a professional tour made with the students under his care, in the province of Gerona, in the spring of 1882.

Another work on the same subject is one published in 1884, *Notas Sobre los Alcornocales, y la Industria Corchera de la Argelia*, por D. José Jordana y Morera, Jefe de Primera Clase del Cuerpo, de Ingenieros de Montes ; publicacion oficial del Ministerio de Fomento—Notes on the Cork Trees and the Cork Industry of Algiers, by Senor Jordana, Chief of the First Class in the Corps of Forest Engineers ; an official publication of the Minister de Fomento.

Appended to the first-mentioned work of Senor Artigas is the following list of works, consulted by him in the preparation of that work, which might prove useful to others engaged in the prosecution of the study of this subject, while it shows what provision was made for facilitating such studies by members of the corps :—

*Alonso de Herrera (Gabriel)*.—Agricultura general.—4 vols. 1818-19. Madrid.

*Barruel (G.)*.—Traite de Chimie appliquee aux arts et a l'industrie, a la pharmacie et a l'agriculture.—5 vols., 1856-60. Paris.

*Baudrillart*.—Traite general des Eaux et Forets, Chases et Peches, &c.—2 vols., 1823-25. Paris.

*Boissier (Edmond)*.—Voyage botanique dans le midi de l'Espagne pendant l'annee 1837.—2 vols., 1839-45. Paris.

*Bosch y Julia (Excmo. Sr. D. Miguel)*.—Memoria sobre la parte Forestal de la Exposicion de Londres de 1862.—1863. Madrid.

*Bosch y Julia (Excmo. Sr. D. Miguel)*.—Memoria sobre la inundacion del Jucar en 1864.—1863. Madrid.

*Candolle (Alphonso de)*.—Prodromus Systematis Naturalis Regni Vegetabilis.—16 vols., 1824-73. Paris.

*Colmeiro (D. Miguel)*.—Catalogo metodico de plantas observadas en Cataluna, particularmente en las inmediaciones de Barcelona.—1846. Madrid.

*Collantes (Excmo. Sr. D. Augustin Esteban)*.—Diccionario de Agricultura Practica y Economia Rural.—7 vols. and an Atlas.—1855. Madrid.

*Comision de la Flora Forestal Espanola*.—Resumen de los trabajos verificados por la *Comision de la Flora Forestal Espanola* durante los anos de 1867-68-69-70.—2 vols., 1870-72. Madrid.

*Costa y Cuxart (D. Antonio Cipriano)*.—Introduccion a la Flora de Cataluna, y Catalogo razonado de las plantas observadas en esta region.—1864. Barcelona.

*Cutanda (D. Vicente)*.—Flora compendiada de Madrid y su provincia, o descripcion sucinta de las plantas vasculares que espontaneamente crecen en este territorio.—1861. Madrid.

*Daunassans (A.)*.—Nouveau dictionnaire d'Agriculture pratique.—1854. Toulouse.

*Duchartre (P.)*.—Elements de Botanique.—1867. Paris.

*Garcia Martino (D. Francisco) y Gonzalez de la Pena (D. Pablo)*.—Revista Forestal, Economica y Agricola.—7 vols., 1868-74. Madrid.

*Girardin (J.)*.—Lecons de Chimie, elementaire appliquee, aux arts industriels.—2 vols., 1860-61. Paris.

*Gomez de Ortega (D. Casimiro)*.—Tratado del cuidado y aprovechamiento de los montes y bosques, &c., por D. M. Duhamel de Monceau, traducido al castellano por el Dr. D. Casimiro Gomez de Ortega.—2 vols., 1873-74. Madrid.

*Grenier et Godron*.—Flore de France, ou description de plantes



qui croissent naturement en France, et en Corse.—3 vols., 1848-50-55. Paris.

*Heyer (Dr. Gustavo)*.—Allgemeine Forst-und-Jagd-Zeitung.—Veintiseis tomos: 1848-74. Frankfurt am Main.

*Joigneaux (P.) et Moreau (E.)*.—Dictionnaire d'Agriculture pratique.—2 vols., Paris.

*Junta Directiva de la Exposicion*.—Memoria sobre los productos de la Agricultura espanola, reunidos en la Exposicion general de 1857-61. Madrid.

*Koch (D. Guil Dan Jos)*.—Sinopsis Florae Germanicae, et Helveticae.—3 vols., 1843-45. Francofurti.

*Laboulaye (C.)*.—Dictionnaire des Arts, et Manufactures de l'Agriculture, des Mines, &c. Description des procedes de l'Industrie Francaise, et etrangere.—2 vols., 1853-54.

*Lambert (Ernest)*.—Exploitation des Forets, de Chene-Liege, et des Bois d'Olivier en Algerie.—1860. Paris.

*Liebeg (Justo)*.—Tratado de Quimica organica publicado en frances por Ch. Gerhardt.—Traduccion en espanol, por Saez y Ferrari.—4 vols., 1837-48. Madrid.

*Parlaione (Filippo)*.—Flora italiana, ossia descrizione, delle piante, che crescono spontanee o vegetano como tali in Italia e nelle isole ad essa Aggacenti.—5 vols., 1848-73. Firenze.

*Pelouze (J.) et Fremy (E.)*.—Traite de Chimie generale, &c.—6 vols. and an atlas, 1855-56. Paris.

*Quer (D. Joseph)*.—Flora espanola o Historia de la plantas que se crian en Espana.—6 vols., 1762-84. Madrid.

*Rozier*.—Nuevo Diccionario de Agricultura-teorico-practica y economica y de Medicina domestica y Veterinaria.—1842-45.

*Societe d'Agriculture*.—Memoires d'Agriculture d'economie rural et domestique, publies par la Societe d'Agriculture.—73 vols., ano IX: 1856. Paris.

*Tessier*.—Annales de l'Agriculture francaise.—ano VI: 1855. Paris.

*Willkohmm (Mauritius) et Lange (J.)*.—Prodromus Florae Hispanicae.—3 vols., 1861-74. Stuttgartiae.

Semanario de Agricultura y Artes, dirigido a los parrocos.—23 vols., 1797-1808. Madrid.

Annales Forestieres.—24 vols., 1842-65. Paris.

Revue des Eaux et Forets.—13 vols., 1862-74. Paris.

Comptes rendus, hebdomadaires des seances de l'Academie des Sciences.—77 vols., 1835-73. Paris.

## SECTION 6.—JURISPRUDENCE AND POLITICAL ECONOMY.

From the first it was considered desirable that in the School of Forestry in Spain, as is the case in those of many, if not also of all such schools in other countries, the students should be instructed in the principles and in the administration of law. In this, as in other departments of study, the professors appear to prepare a programme of what they consider desirable should be taught to the students, which programme requires the approval and sanction of the authorities of the school; and provision was made for this being done in the earlier programmes of those schools which were projected but were not established.

The following is a summary of a handbook of study in this department, issued in 1861, five-and-twenty years ago, which shows what subjects were embraced in this department of study at that time. It is entitled *Lecciones de Administracion Forestal; apuntes de la Clase*—Lectures or Instruction in Forestal Administration; Notes for the use of Students.

It is intimated in the text that what is referred to in the title is the administration of forest law; and under successive heads there are indicated the subjects of successive lectures, embracing:—1. Notions of property in general. 2. Application of proprietorship to the territory of forests. 3. Servitudes. 4. Duty of the State to maintain in favour of itself the legal presumption of the proprietorship of forests on disputed or doubtful property, at least till the contrary be proved and established. 5. That law-suits in regard to forests should always be prosecuted in the most suitable manner, and, if possible, in the regular administrative way, so as not only to facilitate and expedite the suit, but to ensure the execution of the judgment. 6. That the Government administers of its own right the forests of the State; directs for public convenience the service or management of forests belonging to communities and corporations; and in the forests belonging to private proprietors exercises

police powers conformably to the laws and local regulations. 7. Duty and behaviour of engineers in the service. 8. General idea of the organisation of the Government of Spain.

In this handbook the distinction between possession and proprietorship is distinctly drawn. The State, by which it is explained is to be understood the Community, is held to have the sole right to hold land of its own right, but also to have the right to transfer possession, constituting thus what is known as private property, which again may be limited by servitudes, and rights of usage recognised by the State—with the Government as its representative. It is stated that while some nations hold that proprietorship extends *de ceilo a ceilo*—from the surface to the antipodes, Spain, with some other nations, holds that it extends only to a certain depth, the determination of which depth affects the decision of questions raised as to the proprietorship of minerals; and that the proprietorship of forests comprises that of the soil and vegetable covering, herbaceous and lignous. There are discussed changes which have taken place in consequence of the diminished importance of pasturage in forests, and the increased importance of firewood and timber. It is alleged that in Spain the proprietorship of the forests has never been abandoned by the State, and that the tenure or possession is limited by servitudes and usage. Of servitudes there are recognised three categories—urban, rustic, and mixed. In the first mentioned are comprised rights to light, rights to form gardens, and rights of water-flow to and from the property. In the second are comprised right of pasturage, right of erecting fences, with right to the soil for culture of crops, and right of use of forest products; and it is stated that there are special servitudes peculiar to different provinces. It is maintained that the State ought not to part with its legal right of possession, beyond the limits imposed by cosmical, geographical, and social requirements of the country, or of the district, which would be affected by any such transfer;

and there are specified what constitute prescriptive rights of private property, which are confined to what can be supported by legal evidence of just title, and continuous possession for not less than 10, 20, or 30 years, according to circumstances. Importance is attached to proper provision being made for the prosecution of forest misdemeanours and offences, and to safeguards against the miscarriage of justice—the governing Administration having a right to prosecute in the interests of the nation, and the forest officials in cases of wrongs committed in forests belonging to communities and corporations, and even in the case of the forests belonging to private individuals, prosecuting conformably to the laws and local regulations.

The following is a translation of what is stated under the head of Lecture VIII.—General Idea of the organisation of the Government of Spain:—

‘To the formation of a just idea of the Administration of the State, it is necessary to have some knowledge of the nature of government in general, and of the particular distribution of its functions. To communicate this is the object of this lecture.

‘The present Government of Spain is a Constitutional Monarchy, or, what is the same thing, the King rules in accordance with the Constitution of the State.

‘The Constitution establishes three powers; namely, the Legislative, the Executive, and the Judicial.

‘The Legislative power is exercised by the King, with the Cortes. The Cortes is composed of two co-legislative bodies, which are the Senate, the members of which hold office during life, and the Congress of Deputies, who are elected temporarily in the provinces, in accordance with a special law.

‘The King convokes, suspends, and dissolves the Cortes in a form prescribed by the Constitution. With him lies the initiative and the sanctioning of laws; and he may

assemble the Cortes in any place which seems to him convenient. For the promulgation of a law there is requisite the perfect agreement of the co-legislative bodies and the sanction of the King. A law once promulgated, its arrangements cannot be altered excepting by another law enacted by the Cortes; but the Government may explain, and secure the operation of it, by means of Regulations.

‘In general terms it may be said that there pertain to law all the arrangements which effect directly the government of the State; those which create or annul established rights; those which interpret or substantially alter other existing laws; the general arrangements in regard to taxes, and the public service, or the maintenance of the army and navy, which ought to be voted annually.

‘The laws ought to embody in a concrete form, and to establish rules. The Regulations ought to explain the application to be made of the same; and special Instructions of Service, special details required in the execution of the Regulations in any case, and to determinate cases of which they treat.

‘There is nothing more difficult or more important in practice than to determine how far the Precepts of a law ought to extend; at what point the arrangements in the Regulations ought to begin to operate; and what are the details which ought to be entrusted to the Instructions of Service. Hitherto, so great has been the want of agreement on these points, that the greater part of the laws may be frustrated, or made of no avail in practice, by comprising in the law what ought to have been left to the discretionary flexibility of regulations, and by including in regulations what can only be pointed out in an instruction of service.

‘The Executive power, as its designation denotes, is that which is charged with the execution of the laws, and with the direction of the government of the State.

‘The King exercises this power, which is called Govern-

ment, in the widest comprehension of the term, by means of responsible ministers. The King participates in the legislative power in the manner which has been indicated, and in respect to the government of the kingdom he holds in his hands the army and the navy; he declares war, makes peace, and signs treaties; he confers all appointments, honours, and dignities; he grants gracious pardons, and he sees to the internal and external security of the State.

‘The Judicial power is exercised in the name of the King by tribunals of justice, whose powers are confined to judging, and carrying their judgments into effect.

‘This power holds as fundamental the immutability of justice, because in no other way can be conceived the independence of the tribunals; but the circumstances of the country have not hitherto permitted the establishment of this immutability, and consequently it may be said that this power has not existed amongst us hitherto, as it is recognised by the constitution of the State. On the other hand, the constitution assumes that we cannot have more than one standard for the Spanish people; and that the whole kingdom must be governed by codices, which has not been absolutely realised.

At present, besides the ordinary jurisdictions, there exist those of war and the navy, the ecclesiastical, the special judicatories of the exchequer, and the tribunals of commerce. Lest any case should arise which is not fully provided for by these tribunals, the powers of the common courts are curtailed to some extent by the establishment of what is designated the Judicial Administration sanctioned among us by special laws with an appropriate prescribed procedure, and with a recognised place between the judicatories and tribunals, in which it exercises the supreme functions of the Council of State.

‘It will be understood that these indications are confined to the matters of fact, without entering upon a discussion of the principles involved, which would be arduous and delicate enough under whatever conception the subject might be brought under consideration.

‘In representative Governments the King alone is inviolable; all the other public functionaries are responsible for their acts, as strictly speaking there is no sovereign power but the legislature.

‘The responsibility of the Ministerial Secretaries of Despatch is to the Congress and Judges of the Senate sitting as a constituted tribunal of justice. Accomplices of Ministers in delinquencies, are however, judged by the Senate itself. In the trials of other functionaries these are heard according to their classes by the tribunals to which they severally pertain.

‘The King holds by the Constitution the power of submitting to the cognisance of the Senate, as tribunal of justice, grave crimes committed against his person or dignity, and against the security of the State.

‘The Senate sits, moreover, as a tribunal in criminal trials of Senators.

‘The King exercises the government of the State as Supreme Chief of the Executive power, by means of seven Ministers. These are that of the State, that of Grace and Justice, that of War, that of the Navy, that *De Haciendo*, that of the Government, and that *De Fomento*.

‘The seven Ministers form a Council, which is under the presidency of one of their number, with or without a portfolio, who is usually he who has been entrusted by the King with the formation of the Cabinet. In this Council are treated the general business of the State, and those special matters which give form to the law. The Royal Decrees are always issued with the accord of the Council of Ministers, and to that extent involve obligations on all the authorities and dependencies of those Ministers.

‘The president ought to take upon himself the direction of foreign affairs, and what relates to the general statistics of the kingdom. If he do not do so he delegates these functions to other Ministers, by virtue of Royal Decrees.

‘The responsibility involved in resolutions of the Council of Ministers is collective, and cannot be confined to any particular Minister.

'1. THE MINISTER OF STATE, or of Foreign Affairs, as he is designated in other countries. By this Minister is managed such business as arises from abroad; and for the management of this he has a diplomatic corps, which attends to the affairs of Government, and a consular body, which has under its immediate charge what relates to the commerce of Spaniards at the places of their residence.

'The Diplomatic Corps is composed of Ambassadors, Ministers-Plenipotentiary, Resident Ministers, *Chargés d'Affaires*, Secretaries of Embassy or of Legation, and effective *attachés* with a salary, and honorary *attachés* without position.

'The Ambassadors represent the person of the King, with powers to treat of all kinds of business.

'The Ministers-Plenipotentiary represent the Government, and hold likewise ample powers.

'The Resident Ministers attend only to ordinary business, and such extraordinary business as may be entrusted to them.

'The *Chargés d'Affaires* are those who act as substitutes for resident Ministers, and may be entrusted with most kinds of business, but more as a commission than as a function of their position.

'The Secretaries of Embassy and Legation exercise functions indicated by these designations; and the *attachés* are a kind of official auxiliaries, who work under the immediate orders of the Secretaries.

'The Consular body consists of Consuls and Vice-Consuls. To Consuls of the first class is given the title of General. Those who serve in states on the coast of Africa, and in some places in India, discharge functions connected with the charge of commercial business, but they pass nevertheless into the position of the diplomatic corps.

'The Consuls possess public credit, and may certify as notaries documents and papers which are granted by Spaniards, within the limits of their respective consulates. They may, moreover, also intervene in the execution of



testamentary deeds, and proceedings relative to prizes, damages, and other similar matters. In general, the Consuls represent officially the personal rights of Spaniards; but they do not possess any footing in the representation of affairs of Government, which pertains to the diplomatic corps, or only do so in special specified cases, if these have been entrusted to their charge.

‘In the interior of the kingdom there depends on the Ministry of State the supreme ecclesiastical court *De la Rota*; the office of interpreters; the general commissary of the holy places at Jerusalem; the negotiations with Rome relative to public worship; the permanent Deputation of the *grandees*; the disposal of the crosses of the Golden Fleece, of Charles III., of Isabella the Catholic, and of the noble dames of Maria Louisa and St. John of Jerusalem; the four Societies of the knighthood of the kingdom, namely those of Seville, Granada, Valencia, and Ronda. There pertains, moreover, to this Ministry certain functions in the internal government of the palace; these, however, are not at present in use. By this Ministry also are dispensed the rewards of the *Grandees* of Spain, and are ordered the ceremonies to which these concessions give occasion.

‘2. THE MINISTER OF GRACE AND JUSTICE. This Minister, as the name indicates, has charge of business relating to the ordinary administration of justice in the kingdom; the dispensing of grants and rewards; the affairs of the Royal ecclesiastical patronage; and the Seal of the State; with the higher notarial powers of the kingdom exercised by the Minister.

‘The principal functions of this Ministry in the department relating to justice are:—1. To see that this is administered exactly and completely by the tribunals of ordinary jurisdiction, suspending from their functions and prosecuting any judges who fail in their duties. 2. To nominate, in accordance with the laws, the ministers of the supreme tribunal of justice, the magistrates and fiscals of

the courts, and the judges of first instance and prosecuting fiscals, and the other under-officers of the courts, be they clerks, notaries, recorders, or other subaltern officers of justice; and amongst other duties to present or instal such as hold office by right of inheritance, and who consequently cannot be elected. 3. To provide the material which the tribunals require for the performance of their service with becoming decorum. With regard to the department relating to grants and rewards, it has charge of pardons, concessions of Titles of Castile, the habilitation of minors in the administration of their possessions; and, in general, all those dispensations of law called grants of extract, for which certain dues must be paid to the Chancery. With respect to ecclesiastical patronage, this Ministry is charged with the presentation of the archbishops and bishops to the Pope; the nomination of canons and ecclesiastical prebendaries, according to the form established by the concordat; the provision of curates in accordance with the minutes of competition which come from the dioceses; the protection of the clergy, by recourse to force if necessary; the promulgation, or it may be the *exequatur*, of bulls and pontifical briefs; the disposal of the funds granted for the maintenance of worship and of the clergy; and in general, all business relating to the economic regimen, the policy, and the protection of the Church, of which the King is the permanent and supreme defender in Spain.

Moreover, the Council of the military orders of Santiago, Calatrava, Alcantara, and Montesa, depend on this Ministry for the episcopal functions which they discharge in the Churches of the order—which, by the last concordat, has been reduced to a very small number indeed.

The Seal of the State is entrusted to the Chancery of this Minister, on whom, moreover, depends the decision relative to the circumstances which require its application to executed deeds; and the notarial record of the power exercised by the Ministry of Grace and Justice alone sanctions its use in authenticating solemn deeds in the

State, such as those relating to the birth and marriage of the Princes, Acts of the Cortes, and other similar matters.

‘3. THE MINISTER OF WAR. The Secretary of State, entrusted with the despatch of the business of this Ministry, has under his charge all business relating to the *personnel*, the material, the service and the administration of justice, of the military in peace and in war. The *personnel* comprises all, from the captain-general of the army to the soldier inclusive. The Government business, of every kind which has reference to these persons, is discharged through the *Direction-Generals* of the armies of infantry, cavalry, artillery, and engineers, and the *Inspection-Generals* of the organisations of the civil guard, and of the carabineers of the coast and the frontier. These corps, it may be well to remark, depend also, the first on the Ministry of Government, and the second on the Ministry *De Hacienda*; they are, however, dependant on all that relates to their organisation, recruiting, and discipline, on the Minister of War. Personal affairs, and privileges of war, are also attended to by this Ministry, with the difference that complaints are sent through the captains-general in their places of retirement, or those in which they reside, and not through the *Direction-Generals* of the army. Also the material of victuals, clothing, hospitals, and utensils pertaining to the corps of administration and military health, and the armament of the troops, and places for the manufacture of powder, parks of artillery, and foundries, are under charge of the corps of artillery. The works of fortification, with their dependencies in peace and war, pertain to the Corps of military engineers. The service is directed in the provinces by the captains-general, and in the field by the generals-in-chief of the army.

‘Justice is administered by Councils of War, when it has to do with purely military crimes; and by the tribunals of the captains-general of the provinces when it has to do with civil cases, or criminal trials for common crimes,

‘The Courts-Martial are held by the captain when the accused is a member of the troop; and by general officers when the accused is an officer, whatever may be his rank. The sentences of the captain’s court are executed only with the approval of the captain-general of the district. Those of the courts of generals, when they are condemnatory, require the confirmation of the King, after previous advice by the Supreme Tribunal of war and marine.

‘The Corps of Artillery, Engineers, and Military Administration, retain their own special courts. These courts take cognisance in the first instance of business, and disputes relative to the *personnel*, material, and service of these corps; and the appeals from these courts are addressed to the Supreme Tribunal of war and marine, in the same form as is used by the courts of the captains-general.

‘The civil pleas and criminal trials of those who infringe the laws of war, are prosecuted and decided in the courts of the captains-general. The tribunals of common law take cognisance of litigations relative to inheritances. Amongst those who are holders of privileges there are some who are entirely subject to military law, that is to say whether relating to civil or criminal prosecution—others are so only in regard to criminal proceedings.

‘The ordinary courts-martial are composed of the captain-general of the district, of an auditor, a fiscal, and a clerk or war secretary. When the captain-general dissents from the judicial sentence of the auditor he remits the proceedings to the decisions of the Supreme Tribunal of war and marine.

‘The infantry and cavalry, and the special corps of artillery and engineers, have their respective schools of cadets. The military administration manages the establishment of these.

‘The supreme assemblies of the military orders of San Fernando and San Hermenegildo, have charge of the Supreme Tribunal of war and marine,

‘THE MINISTER OF MARINE. The organisation of this Ministry is analogous to that which exists in the Ministry of War, just detailed, with the difference that the *Directions* and *Inspections* of the different institutions and services are connected with the secretariat of the office.

‘In the nomenclature of these *Directions*, and in the names of the *personnel* of the navy, may be noted certain variations which it may be well to indicate, that they may not be confounded with those of the army when there is occasion to make use of them.

‘The *Directions-General* of the Navy, attached to the secretariat of business, are known under the following names:—The *Directiva Junta*, or Council of the Minister; the Direction of marine engineers; Direction of armament, expeditions, and stores; Direction of the *personnel*; Direction of the marine list, and the *personnel* of crews; Direction of marine, artillery, and infantry; Direction of accounts, and of the administrative corps.

‘In the naval military *personnel*, the gradations of rank and their names are in every respect similar to those of the army, but the major-generals are called chiefs of the squadron or admirals; the colonels, captains of the navy; the lieutenant-colonels, captains of frigates; captains, lieutenants of the navy; lieutenants, ensigns of the navy; and the cadets, marine guards.

‘In the *personnel* of the crew, those who attend to the observation and direction of the boats are named pilots; boatswain and boatswain’s mate are names given to kinds of sergeants holding on ship-board a position similar to that of these in the army; and ship boys and cabin boys, to those of the rank of troopers in the army. In the navy they have only three Captains-general of Departments, which are those of Cadiz, Carthagena, and the Ferrol. Those which exist in foreign provinces are called Commandants-general, or Commanders of naval stations.

‘The administration of justice in the navy constitutes a distinct jurisdiction, as does that of the army; and it is

administered by the commandants of the naval stations, and auditories of departments, subject to appeal to the Supreme Tribunal of war and the marine.

‘The enlistment of the crews of the navy is governed by special ordinances, and they enjoy the privileges of the navy, with other exemptions and privileges in ports.

‘There is a Naval College, for the instruction of the marine guard, in the city of San Fernando; and various special schools in different places for the training of marine engineers, naval artillery, and pilots for the merchant service.

‘THE MINISTER DE HACIENDA, or of Finance. By this Ministry is transacted all business relative to the possessions, rights, imposts, contributions, and general charges of the State.

‘For the discharge of these functions there are constituted departments of the Ministry: the direction-general of the treasury; that of accounts of State funds; that of general contributions; that of revenues of monopolies; that of taxes on articles consumed, the money office, and the mines; that of duties and customs; that of lotteries; that of the bank of deposit; that of the properties and dues of the State; and that of general assessments of the chancery. There depend, moreover, on the same Ministry the court of exchequer; the direction-general of the public debt; the commission de Hacienda of Spain in foreign lands; the junta of elective classes; that of the sale of national possessions; that of regulations; and that of the portion of the corps of carabineers engaged in the service of this Ministry; with other dependencies of lesser importance.

‘In the Ministry of Finance are collected the estimates of income and expenditure of the other Ministries; and by it is presented to the Cortes the budget or general estimates of the State.

‘The Administration of Justice special to the exchequer is confined to affairs which are within its own competency;

and is secured by special courts, appeals from which go to the audiences of the territory, where this Ministry has fiscals appointed by itself there to defend its rights.

‘We may summarise the functions of this department by saying that the Minister de Hacienda is the only administrator and collector-general of all possessions and revenues pertaining to the State. It is important to notice that having the supremacy over the ancient *Intendancies de Hacienda* which exist in the provinces, it exercises the principal powers in the civil governments of these.

‘THE MINISTER OF EXECUTIVE GOVERNMENT. This Ministry, as its designation indicates, has in charge the interior administration of the kingdom, in its multiple and separate branches; but experience having demonstrated the difficulty, if not the impossibility, of one Ministry being able alone to undertake the charge of such vast and extensive dependencies, it was deemed necessary to form separate Ministries to attend to the more important departments of these—creating, as has been done in France and other nations, Ministries of public works, agriculture, commerce, and public instruction, to which have been given the names of these particular departments.

‘The Spaniards, to effect such division, have formed two great groups, giving to the one the name of the *Gobernacion*, and giving to the other that of *Fomento*, charging each respectively with the functions which these names continue to describe.

‘The Ministry *de la Gobernacion* discharges business relating to the public administration, and the governing regimen of the population, by means of the directions-general of the administration; the post office; penal establishments; beneficence; health; and telegraphs.

‘In the provinces it exercises the government by civil governors, assisted by provincial councils and courts of provincial deputies, of which they *ex-officio* are presidents. The local government of the population is dispensed by *Alcaldes*, Mayors, or rather by the *Alcalde-Corregidores*, where there

are any ; assisted one and other by *Ayuntamientos*, or Town Councils, corporations which, like the courts of provincial deputies, although popularly elected, perform various economical functions dependent on the Government.

‘The laws of 1845 limit the power of these deputies and *ayuntamientos* to business purely administrative, and it is also required, in regard to the greater part of their decisions, that they should receive the approval of the Government.

‘The Administration of Justice in disputed administration is under the charge of this Ministry, and consequently dependent on it are the Council of State, and the provincial councils, to which is entrusted the cognisance of appeals. Moreover, in dependence on this Ministry are the Council and provincial juntas of the health of the kingdom ; the Academies of medicine and surgery ; the Pharmaceutical college of Madrid ; the medical officers of medicinal baths ; the Aranjuez college for orphans ; the savings banks ; the *Monte de Piedad* of Madrid ; the Junta for aid to prisoners ; the Government printing press.

‘The same *Ministry of Government* attends to the regulation of the press ; the election of deputies to the Cortes ; the election of provincial deputies, and of *ayuntamientos* or town councillors ; and carries on the correspondence with the co-legislative bodies in all matters in which the Government has to correspond with them. Finally, it has at its orders the civil guard, which is a corps of the army of from 10,000 to 12,000 men—as remarkable for its organisation, as distinguished by its services. The rural guards is also dependent on this Ministry.

‘THE MINISTER DE FOMENTO. This Ministry has under its charge public instruction ; agriculture, industry, and commerce ; and public works. There are entrusted to this Ministry vast and complicated interests ; but there are not given to it agents of its own in the provinces, so that its principal representative and director of operations is everywhere the civil governor of the province ; and this



functionary is appointed by, and depends immediately upon, the *Ministry of Government*. This difficulty has not passed unobserved in this department; and it not having received power to create equal superior chiefs in each of the provinces, this has led to one of those inconveniences which occasionally occur—the despatch of business by partial arrangements, which do not accomplish all that was designed; and this in the end has led to the formation of *Sections de Fomento*, which in reality are no more than a kind of special secretariat of the governors, appointed by the *Ministry de Fomento*, to hear, consider, and formulate the resolutions of the said governors on matters pertaining to this Ministry.

‘On the *Ministry de Fomento* depends for the direction of public instruction the royal council of that name; and all the universities, institutes, academies, general archives and libraries of the kingdom; the schools, as well superior as professional and industrial; with all the other provincial and local establishments designed for communicating instruction in its various forms and grades.

‘On the Direction-General of Agriculture, Industry, and Commerce depend the *personnel*, material, and service of the corps of engineers of mines and of forests, with their Facultative Juntas or professional councils, and their special schools; the Royal council of agriculture; the Royal commissions; the juntas and committees of the provinces; the oversight of the breed of horses; the general association of cattle rearers; the economical societies; the tribunals and juntas, or councils, of commerce.

‘On the Direction-General of Public Works depend the corps of engineers of roads, canals, and bridges, with the consultative council, and the special schools of the department; the syndicates of irrigation; and also all committees of inspection of other kinds whatsoever, which have to do with railways, waters, light-houses, and public works of other kind whatsoever among dependencies of the *Ministry de Fomento*. The diplomas or commissions of professional careers are issued by the *Ministry de Fomento*.

‘The Engineers of Mines, Roads, and Forests hold Royal warrants for the ranks entrusted to them in their corps, with continuous salary.

‘It may be well to bear in mind, in view of cases which may occur, that the department of forests had, until the second period of the century, a directing and administrative relation with the Ministry of marine with its own tribunals, and a multitude of powers and privileges which have disappeared being courts incompatible with the legislation now in force.’

With regard to the government of colonies it is added:—‘The possession abroad, according to the constitution of the State, should be governed by special laws. These laws, however, have not yet (1861) been enacted, consequently the islands of Cuba and Porto-Rico, the Phillipines and Fernando, Po, &c., continue to be governed by the old laws of the India, and by ordinances, and Royal decrees, which are issued to meet cases as they arise. The inhabitants of these are not represented in the congress of deputies; but they are in the Senate, when there occur the conditions prescribed for that case. The Captains-general of some dominions hold the supreme position in all branches of the public administration; but these are subject to be called to account before the Supreme Tribunal of justice when they terminate their appointment.

‘Through the Direction-general of foreign affairs they discharge under the president of the council of ministers, or on the minister substituted for him in this matter, the business assigned to the Ministries of grace and justice, *hacienda*, government, and *fomento*.

‘The despatch of affairs of State, of war, and of marine, is retained in the hands of the ministries of the peninsula, as the nature of such business does not admit of its being separated. It is, however, enjoined that the secretaries of despatch of the ministries mentioned shall send to the Direction of foreign affairs a list of the orders which they

have communicated—these being communicated to the authorities by the secretaries, in order to prevent the occurrence of contradictory arrangements relative to the same affairs being sent by two or more ministries, as has repeatedly occurred in some remote countries when these conflicting orders were followed with fatal effect, as well in respect to the service as in respect to the prestige of the government at the capital, which it is of much importance to maintain in these.’

The citation is a long one ; but the matter may prove not without interest to some of my readers while it supplies at once an illustration of the comprehensiveness of the course of study followed in the School of Forest Engineers in Spain, and the exhaustive character of the studies.

#### SECTION 7.—GENERAL FORESTAL LITERATURE.

The accounts given under preceding headings of different works were designed simply to supply some illustration of the kind of provision made for students in the School of Forest Engineers prosecuting their studies in each department of instruction embraced in the programme, being accounts of books taken almost at random in so far as this use of them was concerned. They supply an average, not a special indication of what is provided ; and the provision is much more copious than these citations alone would indicate. Mention has been made of the number of books in the library of the school being, according to information in my possession when previous sheets were sent to press, being 5665 ; from information since communicated to me I learn that they now number upwards of 7000.

In an appendix to an *Escalafón* of the Corps of Forest Engineers which appeared in the *Revista de Montes*, on the 1st July this year, 1886, there is given the following list

of works published of late years by members of the corps, copies of all of which are accessible to the students. The arrangement followed is that of the alphabetical order of the names of the authors :—

ACEBAL DEL CUETO (D. Ricardo).

*Proyecto de casa de guardas para el monte Pelono*.—Madrid, 1885.

ALVAREZ SEREIX (D. Rafael).

*Determinacion de la masa lenosa de un monte*, por P. Nico (Translated from the Italian).—Madrid, 1880.

*Cartas de Navarra*.—Madrid, 1880.

*La desamortizacion forestal*.—Madrid, 1883.

*Estudios botanico-forestales (1ª serie)*.—Madrid, 1885.

*Geografia botanico*.—Lugo, 1884.

*Estudios botanico-forestales (2ª serie)*.—Madrid, 1885.

*Cuestiones cientificas*.—Madrid, 1885.

*La opinion de la prensa sobre los montes publicos*.—Madrid, 1886.

*Discursos pronunciados en la Asociacion de Agricultores de Espana*.—Madrid, 1886

*Adiciones y enmiendas a la ultima edicion del Diccionario de la Academia Espanola*.—Madrid, 1886.

ARRILLAGA Y DE GARRO (D. Francisco de P. de).

*Compendio de Valoracion de montes*, por G. Heyer (Translated from the German).—Madrid, 1871.

*La produccion forestal en la Exposicion universal de Viena*.—Madrid, 1875.

*Resena del Congreso y Exposicion de Geografia en Venecia*.—Madrid, 1882.

ARTIGAS Y TEIXIDOR (D. Primitivo).

*El alcornoque y la industria taponera*.—Madrid, 1875.

*Resena critica de la obra (Le chene-liege en Algerie)*, por M. A. Lamey.—Madrid, 1881.

*Los torrentes de Barcelonnette*.—Madrid, 1881.

*Breve resena critica relativa a la obra intitulada (Nota sobre los atcornocales y la industria corchera de la Argelia)*, por D. Jose Jordana y Morera.—Madrid, 1883.

*Memoria relativa a la excursion verificada por los alumnos de la Escuela especial de Ingenieros de Montes a los montes publicos, dunas y alcornocales de la provincia de Gerona por el verano de 1882.*—Madrid, 1885.

*Alcornocales.*—*Industria taponera.*—Madrid, 1885.

*Dunas.*—Madrid, 1885.

BACHILLER (D. Buenaventura).

*Dictamen sobre las causas que influyen en las continuadas sequias que experimenta la provincia de Valencia y medios que tiendan a corregir las.*—Valencia, 1878.

BOSCH Y JULIA (D. Miguel).

*Manuel de mineralogia.*—Madrid, 1858.

*Manuel de botanica.*—Madrid, 1858.

*Memoria sobre la parte forestal de la Exposicion de Londres de 1862.*—Madrid, 1863.

*Memoria sobre la inundacion del Jucar en 1864.*—Madrid, 1866.

*Parte forestal de la ultima Exposicion de Paris.*—Madrid, 1869.

BRAGAT Y VINALS (D. José).

*Guia practica para combatir y atajar la phyloxera vastatrix.*—Zaragoza, 1878.

*Influencia de los montes en la hidrlogia de un pais.*—Zaragoza, 1879.

BRENOSA Y TEJADA (D. Rafael).

*Estacion meteorologico-forestal de San Ildefonso.*—Madrid, 1882.

*La porfirita y microdiorita de San Ildefonso y sus contornos.*—Madrid, 1834.

*Una macla de yeso.*—Madrid, 1885.

*El dimorfismo del basilito de cal.*—Madrid, 1885.

*Guia del Real Sitio de San Ildefonso (En colaboracion con el Sr. Castellarnau).*—Madrid, 1885.

CAMPUZANO Y BROCHOWSKI (D. Antonio).

*Sistema de podas de arbolado, con notas.*—Madrid, 1864.

CASTEL Y CLEMENTE (D. Carlos).

*Monografia dasografica del ha, a.*—Madrid, 1873.

*Memoria sobre la Influencia de la luna en la vegetacion.*—Madrid, 1875.

*Memoria sobre la fundacion y desarrollo de la Escuela especial de Ingenieros de Montes.*—Madrid, 1877.

*Estudios sobre el tanino* (Memoria premiada por la Real Academia de Ciencias).—Madrid, 1879.

*Descripcion fisica, geognostica, agricola y forestal de la provincia de Guadalajara.* (Publicada por la Comision del Mapa geologico de Espana.)—Madrid, 1882.

*Memoria sobre las condiciones naturales y produccion agricola y forestal de la Peninsula Escandinava.*—Madrid, 1883.

*Combustibles vegetales: Teoria y practica de la combustion, carbonizacion y destilacion de la madera.*—Madrid, 1885.

#### CASTELLARNAU Y DE LLEOPART (D. Joaquin Marie de).

*Estudio ornithologico del Real Sitio de San Ildefonso y sus alrededores.*—Madrid, 1877.

*Estudio micrografico del tallo del pinsapo.*—Madrid, 1881.

*Estudio micrografico de la madera de la coniferas espanolas, y especialmente del genero (Pinus).*—Madrid, 1884.

*Guia del Real Sitio de San Ildefonso.* (En colaboracion con el Sr. Brenosa).—Madrid, 1885.

*Vision microscopica.*—Madrid, 1885.

*La estacion zoologica de Napoles y sus procedimientos para el examen microscopico.*—Madrid, 1885.

*Descripcion microscopica de la madera del Quercus Jordanae.*—Madrid, 1885.

#### CERON Y MARTINEZ (D. Salvador).

*Cultivos de las estepas y dunas de las provincia de Cadiz.*—Madrid, 1877.

*Industria forestal-agricola.*—Cadiz, 1879.

*Estudio sobre los materiales y efectos usados en la marina.*—Cadiz, 1883.

#### COMPANO Y ROSSET (D. Manuel).

*Apuntes de botanica.—Fitografia.*—Escorial, 1884.

#### DIAZ OYUELOS (D. Jose).

*Prontuario forestal.*—Burgos, 1877.

DIAZ ROCAFULL (D. Aurelio).

*Legislacion del ramo de montes.*—Madrid, 1881.

DIEZ DE ANDINO (D. Julian).

*Cartilla de selvicultura.*—Santander, 1860.

ESCOSURA Y CORONEL (D. Luis de la).

*Manual del capotaz de cultivos.*—Madrid, 1877.

*La Phyloxera.*—Madrid, 1878.

*Breves consideraciones sobre estatica quimica forestal.*—Madrid, 1879.

ESCRIRANO Y PERFZ (D. Jose Maria).

*Pomona de la provincia de Murcia.* Memoria premiada por la Real Academia de Ciencias.—Madrid, 1884.

FENECH Y ARTELLS (D. Antonio).

*El voto particular del Sr. Moret.*—Pontevedra, 1883.

*Los montes publicos de Galicia.* Memoria premiada por la Sociedad de Juegos florales de Pontevedra.—Madrid, 1884.

GARCIA MACEIRA (D. Antonio).

*La agricultura salamantina; sus males y sus remedios.*—Salamanca, 1871.

*La cana de azucar.*—Madrid, 1875.

*Apuntes y noticias sobre la agricultura de los arebes espanoles.*—Salamanca, 1876.

*Beneficios de las aves insectivoras.* Obra premiada en concurso publico.—Madrid, 1882.

*Estudio de la invasion en los montes de la provincia de Salamanca del insecto llamada vulgarmente Lagarta.*—Madrid, 1885.

*Leyendas salmantinas.*—Madrid, 1885 y 1886.

GARCIA MARTINO (D. Francisco).

*Historia y literatura de la ciencia forestal en Alemania.*—Madrid, 1869.

*Consideraciones economicas sobre la propiedad forestal.*—Madrid, 1869.

*Un problema de la ciencia de montes.*—Madrid, 1869.

*Memoria sobre los trabajos ejecutados por la Direccion general de Estadistica.*—Madrid, 1870.

*Los montes y el Cuerpo de Ingenieros en las Corles Constituyentes.*—Madrid, 1871.

HOCEJA Y ROSILLO (D. Javier).

*Manual de entomologia.*—Dos tomos.—Madrid, 1881 y 1882.

*Influencias del arbolado.*—Madrid, 1883.

JORDANA Y MORERA (D. José).

*Apuntes bibliografico-forestales.*—Madrid, 1875.

*Los montes y la colonizacion en Australia, Tasmania y Nueva Zelanda.* En colaboracion con D. Juan Morphy.—Madrid, 1878.

*Apuntes sobre los montes y la agricultura norteamericana.* En colaboracion con D. S. Vidal.—Madrid, 1878.

*La agricultura, la industria y las bellas artes en el Japon.*—Madrid, 1879.

*La agricultura y los montes de los Estados Unidos.*—Madrid, 1880.

*La produccion agricola y forestal de la Argelia.* En colaboracion con los Srs. Madrid-Dávila y Robles.—Madrid, 1882.

*Notas sobre los alcornocales y la industria corchera de la Argelia.*—Madrid, 1884.

*Curiosidades naturales y caracter social de los Estados Unidos.* Madrid, 1884.

*El Monasterio de Piedra visto al natural.*—Madrid, 1885.

*Novelas norteamericanas* (translated from the English).—Madrid, 1885.

JORDANA Y MORERA (D. Ramón).

*Memoria sobre la produccion de los montes publicos de Filipinos en el ano economico de 1871-72.*—Madrid, 1874.

*Idem de 1872-73.*—Madrid, 1874.

*Idem de 1873-74.*—Madrid, 1876.

*Idem de 1874-75 y 1875-76.*—Madrid, 1879.

*Manual de la cria de animales domesticos.*—Madrid, 1882.

*Manual de podas e injertos de arboles frutales y forestales.*—Madrid, 1882.

*Bosquejo geografico e historico-natural del Archipelago filipino.*—Madrid, 1885.

*Guia del viajero de Barcelona a Manila por el canal de Suez.*—Madrid, 1886.



## LAGUNA Y VILIANUEVA (D. Máximo).

*Memoria de reconocimiento de los montes de Sierra Bullones pertenecientes a España.*—Madrid, 1861.

*Memoria de reconocimiento de la Sierra de Guadarrama bajo el punto de vista de la repoblacion de sus montes.*—Madrid, 1864.

*Excursion forestal pos los Imperios de Austria y Rusia.*—Madrid, 1866.

*Resumen de los trabajos verificados por la Comision de la flora forestal Espanola.* Dos tomos.—Madrid, 1870 y 1872.

*Un nuevo roble de la flora de Filipinas.*—Madrid, 1875.

*Discurso leido ante la Real Academia de Ciencias exactas, fisicas y naturales.*—Madrid, 1877.

*Coníferas y amentaccas espannolas.*—Madrid, 1878.

*Cien helechos de Filipinas.*—Madrid, 1878.

*Un mesto italiano y varios mestos espannoles.*—Madrid, 1881.

*Que son las plantas.*—Madrid, 1883.

*Flora forestal espanola.* Con un atlas de 50 laminas cromolitografiadas.—Madrid, 1883.

*Caracteres de la flora Espannola.*—Madrid, 1884.

## LEON DEL RIVERO (D. Roque).

*Memoria de ordenacion de la Reales Matas de Valsain.*—Madrid, 1886.

## LLAURADO Y FABREGAS (D. Andrés).

*Tratado de aguas y riegos,* Dos tomos.—Madrid, 1886.

## MONTES Y PEREZ (D. Victoriano).

*Dictamen sobre la scausas que influyen en las continuadas sequias que experimenta la provincia de Almeria y medios que tenderian a corregirlas.*—Madrid, 1879.

## MUNOZ DE MADARIAGA (D. Juan José).

*Lecciones de petrografia aplicada.*—Madrid, 1878.

*Manual de mineralogia.*—Madrid, 1880.

*Manual de geologia.*—Madrid, 1881.

*Lecciones de quimica aplicada.*—Madrid, 1886.

NAVARRO REVERTER (D. Juan).

*Del Turia al Danubio: Memoria de la Exposicion universal de Viena.*—Valencia, 1875.

OLAZABAL Y ALTUNA (D. Lucas).

*Suelo, clima, cultivo agrario y forestal de la provincia de Vizcayo.* Memoria premiada por la Real Academia de Ciencias.—Madrid, 1857.

*Proyecto de ley de montes.*—Madrid, 1877.

*Ordenacion y valoracion de montes.*—Madrid, 1883.

*Sobre la desamortizacion de los montes publicos proyectada por el Sr. Camacho.*—Madrid, 1884.

PARADA Y BARRETO (D. Adolfo).

*Claves dicotomicas para la determinacion de los tipos, clases, ordenes y familias en los reinos animal y vegetal*—Madrid, 1878.

PARDO Y MORENO (D. Eduardo).

*Apuntes sobre el esparto.*—Madrid, 1865.

PASCUAL (D. Agustin).

*Estudios forestales.*—Madrid, 1852.

*Resenna agricola de Espana* Se publico en el *Anuario de Estadistica* correspondiente a 1858.—Madrid, 1859.

*Informe de la Junta Facultiva del Cuerpo de Ingenieros de Montes con motivo de la desamortizacion forestal.*—Madrid, 1855.

*Sobre el vocablo forestal.*—Madrid, 1869.

*Sistemas forestales.*—Madrid, 1870.

*Discurso leido ante la Real Academia Espanola.*—Madrid, 1870.

PLA Y RAVE (D. Eugenio).

*Maderas de construccion naval.*—Madrid, 1875.

*Marcos de maderas para la construccion civil y naval.*—Madrid, 1879.

*Tratado de maderas de construccion civil y naval.*—Madrid, 1879.

*Manual de cultivos agricolas.*—Madrid, 1879.

*Manual de cultivo de arboles frutales y de adorno.*—Madrid, 1880.

*Manual de cultivo de arboles forestales.*—Madrid, 1880.

*Manual del maderero.*—Madrid, 1882.

PUIG Y VALLS (D. Rafaél).

*Breves consideraciones sobre la importancia industrial, minera, agrícola y forestal de la alta cuenca del Llobregat.*—Madrid, 1881.

ROMERO Y GILSANZ (D. Felipe).

*Articulos sobre una cuestion de montes.*—Valladolid, 1883.

RUIZ AMADO (D. Hilarión).

*Manual de legislacion y administracion forestal.*—Gerona, 1859.

*Estudios forestales: Los monte en sus relaciones con las necesidades de los pueblos,* Dos tomos.—Tarragona, 1870 y 1872.

*Tablas taquimetricas.*—Barcelona, 1885.

UGALDEZUBIAUR (D. Santiago).

*Memoria descriptiva de la provincia de Manila.*—Madrid, 1880.

VIDAL Y SOLER (D. Domingo).

*Manual del maderero en Filipinas.*—Manila, 1877.

*La flora filipino agustiniana.*—Manila, 1877.

VIDAL Y SOLER (D. Sebastián).

*Memoria sobre el ramo de montes el la Islas Filipinas.*—Madrid, 1874.

*Apuntes sobre los montes y la agricultura norteamericana.* En colaboracion con D. J. Jordana.—Madrid, 1878.

*Catalogo metodico de la plantas lenosas silvestres y cultivadas observadas en la provincia de Manila.*—Madrid, 1880.

*Resena de la flora del Archipelago filipino.*—Manila, 1883.

*Sinopsis de familias y generos de plantas lenosas de Filipinas.* Con un atlas de 100 laminas.—Manila, 1883.

*Phanerogamæ Cumingianæ philippinaram* —Manila, 1885.

XERICA E IDIGORAS (D. Ramón de).

*La teoria y la practica de la resinacion.*—Madrid, 1869.

In this list is included a volume, which was printed in 1873, not for sale, but for distribution, by Don José Jordana y Morera, to which reference has already been made as a *Catalogue Raisonné*, of upwards of eleven hundred books, manuscripts, maps, and charts, bearing upon forestry and forest science, which had been published in the Spanish language. It is entitled *Apuntes Bibliographico Forestales, o sea breve resumen de los Libros, folletos, articulos, impressos, manuscritos, mapas, planos, y demas trabajos originales o traducidos, por Autores Espanoles, relativos a la cria, cultivo aprovechamiento administracion, legislacion y economia de los montes, arbolados, plantios, prados. caza y pesca*—Forestal Bibliographic Notes, or short *resumés*, of books, pamphlets, papers, short treatises, manuscripts, maps, charts, and other original works, or translations, by Spanish authors, relative to the creation, cultivation, exploitation, administration, legislation, and economy of forests, woodlands, plantations, meadows, the game, and fisheries.

The list comprises works published previous to 1860. By Senor D. Rafael Alvarez Sereix, now of the Government Department of Statistics and Geography, there was prepared and printed a list of works on forest science, published in Spain between the years 1860 and 1881; and he has since prepared a list in manuscript of works published since 1881 to the present time. In these appear most of the works included in the foregoing list of works published by members of the Corps of Forest Engineers.

## CHAPTER V.

### FOREST EXCURSIONS.

At Villaviciosa there were many local advantages enjoyed by the students engaged in prosecuting their studies, and there was formed a *campo forestal* for their benefit. This took much of the character of an arboretum, in which the students might familiarise their minds with the habits of different kinds of trees, acquire some knowledge of the general appearance and natural history of these; and acquire some experience in planting, transplanting, and sowing. But there was no *campo de practicos* in which they could be exercised in any way in forest management; nor was there in the immediate vicinity extensive forests, in which a practical knowledge of what is called in Spain Forest *ordinacion*, or the scientific arrangement of partitions, and of forest exploitations, might be gained. This made it more easy to secure the acquiescence of all concerned in the removal of the school to the Escorial when that was carried out, though, as has been indicated, this was resolved upon on other considerations.

Within the domains of this spacious royal palace there existed formerly pine woods of considerable extent, but these unhappily had been sold, and were being so devastated as to threaten their entire destruction. There were ceded to the school the forests of the Herraria and the Romeral, that in these might be established for the school its own field of operations; but these forests did not admit of the end designed being gained without studies in the replenishing of exhausted forests, and this it was impossible, through lack of means, to effect; and the forests had been so badly treated that for their restoration it would be absolutely necessary to suspend

all exploitation beyond that of depasturing such portion as was adapted for this, to the prevention of that mode of carrying out fellings in the localisation and practical execution of which the students would have found profitable instruction. Still there were some advantages accruing to the school from having possession of these properties—advantages the loss of which was painfully felt when the park of the Casita de Arriba, which had been at first placed at the service of the school, was afterwards withdrawn, and had been for some months under the administration of the Royal patrimony, which at the end of the year freely disposed of the improvements which they found carried out in it.

The Casita de Arriba is a mansion surrounded with umbrageous grounds, situated little more than half a mile from the school. It was erected in 1772 by the Infanta D. Gabriel, and was granted to the authorities of the school to supply the place of the *campo forestal*, or arboretum, at Villaviciosa. The grounds were of such extent as to afford facilities for the students being exercised in the sowing and planting of trees, and being made acquainted with the operations and requirements of silviculture. But the shortness of the time in which it was so used, from 1870 to 1876, did not allow of a great deal being done in the development of it as a exercise field, and when embodied in the Royal patrimony the authorities of the school ceased to have the administration and use of it in forest management; and the privation was felt by them. But there are a number of trees growing in the entrance court of the school; and in a neighbouring street is a *campo forestal* in which the students are exercised in nursery work, but this is limited in extent, and the school was reduced in this respect to a condition not greatly dissimilar to that under which it had been placed at Villaviciosa; but it was not worse. The students still had access to the celebrated pine forests of Valsain, though these were at a distance, and thither they could be taken in spring, on excursions of observation, and exercised, if it were desired, in operations of practical forestry.

From the founding of the school, up to the present time, it has ever been the desire of those taking the deepest interest in it, to raise up a body of able-bodied, strong-minded, well educated, thoroughly trained, and well instructed gentlemen—gentlemen both in the usual acceptance of the term, and in the higher one according to which he gentle is who gentle does,\* heartily devoted to their profession, taking a comprehensive view of the range of matters with which forestry has to do, and able to state distinctly and explicitly in courteous language what in connection therewith they consider the interests of the country require should be done.

His Excellency Senor D. Bernardo de la Torre Rojas, the founder and first director of the school, in a manuscript work preserved in the library of the school, entitled *Apuntes de mi Diaris Particular Relative a la Fundacion de la Escuela y Cuerpo de Ingenieros de Montes*—Notes from my Private Journal relative to the Founding of the School and Corps of Forest Engineers—writing of the importance of combining with the instruction given in the school the practical application of knowledge acquired, and the development in the students of an *esprit de corps*, goes on to say:—‘It is with this in view that I attach so much importance to the development of physical strength in the forest engineers; for I am persuaded that otherwise they will be considered and treated as only poor students, devoid of the strength needed to inspire respect in the *employés* of the department who may be required to accompany them, if they do not on their forest expeditions show themselves to be as strong as they are.

‘Discipline,’ he adds, ‘does not consist, as many others believe, in the simple obedience of the inferior to his superior in what pertains to the service, but it extends to uninterrupted respect in the private intercourse of the classes with each other. The conduct thus spoken of must be based not on the force of prescriptions or

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\* [Mark him who doeth all the good he can,  
And take him for the truest gentleman.]

precepts, which it is so easy to evade, but on the habits of which they see a constant example in the superior chiefs under whom they serve.

‘A body without a soul is a galvanised corpse. An isolated individual is nothing; two are some, and three constitute an integer or entirety if they constitute a corps \* The *esprit de corps*, without discipline, may, however, become a public calamity. But still I would not feel that I had completed the work I had laid out for myself if I did not embody in this basis the idea at least of a matter of so much importance.’

Citing these statements Senor Castel remarks:— ‘These paragraphs which I quote entire, fearing to weaken in the least degree the idea of the founder of our school, it may be seen justify what I have already alleged, that during the period of foundation, and introduction into Spain of what may be called a new science, there could only be made experiments or trials of what had proved the best methods of instruction employed elsewhere; and thus it came about that this acquired an eminently practical character, corresponding to the necessities of the time, and the example which it was sought to follow—that found in the forest academies of Saxony.

‘The studies of topography, which constituted essentially at that time the first year’s section of the course to be followed, were prosecuted more in the field than in the class-room; and such a progress was made in carrying out the principle of having the class-room under the open heavens [what in Britain would be called field lectures] that even the examinations at the end of the session were held in the forest of Las Huelgas, near the banks of the Guadarrama.

‘Many forest engineers there are who still remember with pleasure the examination held on the 21st of July, 1848. There was pitched in the locality mentioned an elegant commodious tent, ornamented with the national

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\* [*Scotticé*.—Ane’s nane; twa’s some; three’s a pickle; four’s a crum.]



shield, and the emblems or symbols of the corps. In this met the professors constituting the tribunal, and there, under the branches of the trees, was exhibited the first authorisation of the formation of a School of Forestry, which was exposed—curious circumstance but appropriate—on the board of a theodolite.

‘To these field exercises there succeeded in the second year, and the others following, forestal excursions to the forests of the Sierra. With disregard of selfish considerations, both professor and students made the journeys on foot, collecting and discussing as they went all objects possessing any interest with which they met, whether these were plants, or insects, or rocks. The strictest discipline, compatible with perfect and expansive freedom, characterised their whole procedure, even in details; and to maintain the enthusiasm and joviality of the *esprit de corps* there was sounded forth by the youthful students the so called *Forest Hymn*, composed by one of them, and enspirited with the purest love of science, of nature, and of their country. Eighteen years later we, the disciples of these students, sing that same hymn, reproducing it in the pineries of the Cordillera of the Guadarrama, and shouting out with a voice which the echo repeats and extends—

. . . . .

‘ Al campo marchemos !  
 Risuena la aurora,  
 Las blancas estrellas,  
 Luciente borro ;  
 Subid ! Pennalara,  
 De nieve vestido,  
 Los rayos nacientes,  
 Refleja del sol.

Mirad como brota,  
 Y baja espumoso,  
 Bannando los riscos,  
 Torrente veloz ;  
 Y roca tras roca,  
 Cruzando el abismo,  
 La cabra ligera,  
 Saltar sin temor,

Mirad de los pinos,  
 Las copas gigantes,  
 Que mece suave,  
 El aura al pasar :  
 Hoy canta en sus ramas,  
 Amores el ave,  
 Mannana iran ellos,  
 Cruzando la mar.'

The verses may be roughly rendered—

We are off for the forest !  
 The smiling aurora  
 Effaces with brightness  
     The white stars of night !  
 Climb up Pandalara,  
 Which in vestments of snow,  
 Reflects clear the bright rays  
     Of the new risen sun.

See ! how yonder bursts forth,  
 And comes down in white foam,  
 Filling full its mountain bed  
     The rushing torrent !  
 While the sure-footed goat,  
 Crossing that deep abyss,  
 Bounds from rock to rock  
     Without tremor or fear !

And afar, the massive crowns  
 Of the mountain pine trees  
 Are swaying gently  
     In the passing breeze !  
 To-day birds in the branches  
 Sing joyfully notes of love :  
 To-morrow these are felled  
     And cross the deep sea !

While one or more sing stanza after stanza—either the same singers or others—all thunder forth a chorus. The chorus may be roughly rendered thus:—

Cotta the learned ! Thy children in Spain  
 Invoke thy name, which is now immortal,  
 To their country promising such fruits  
 As thy genius has produced in Tharand !

Comrades let us follow the path  
 Traced out by the hand of Cotta !  
 Our science will be proved by our work !  
 Our power will be found in union.

The song was, and is, a favourite with the students, and I was told that it was constantly sung by them on their excursions to the forests of the Escorial and of La Grainja, in 1847 and 1848.

I have seen a MSS. copy varying somewhat in phrase and measure, but not in sentiment, with a notation of the air to which it was sung, a strophe being sung in tenor by a single voice, and each verse as an antistrophe sung by another in bass, and then the strophe as a chorus sung by all in tenor and bass in harmony.

The verses I have cited I have heard sung to the air of one of the popular songs of the Revolution.

M. Bourgoing, minister plenipotentiary from France to the Court of Madrid in the end of last century, tells in a work published by him on his return to France, that the forms of poetry in Spain are varied to a singular degree; their language, being very easy of inversion, is capable of all sorts of verses seen in modern language, but they reckon three as those in general use—blank verse without any kind of rhyme, which differs from prose only in the number of feet, and the orderly interchange of the long and short syllables; verses with perfect rhyme, which they call *consonantes*; and what they call *asonantes*, in which are written almost all their old plays, and many of the modern ones. These commonly, says M. Bourgoing, begin in a series of true verses, *consonantes*, either in common rhyme, and with equal feet or in alternate rhyme and unequal measure. After a scene or two, sometimes only a speech or two, comes the turn of the *asonantes*, which generally last to the end of the piece, unless in some part the *consonantes* reappear for a little time. These *asonantes* are a string, often very long, of cadenced phrases subject to a certain measure. Each of them is a verse;

but the *asonante* returns only every other line, and makes no rhyme. It is sufficient that the two last vowels are the same. In illustration are given quotations from classic dramas, in one of which *sirve* and *vides*; in another *tema* and *era*; in another *raras* and *casas, plantas, and probanza*, are *asonantes*; and he goes on to say: without being acquainted with this beforehand, a foreigner might frequent the Spanish theatre for years without perceiving the existence or effect of the *asonantes*; and though he be put into the way he will often have much trouble to trace them when he hears them on the stage. But what is so difficult for him to catch at does not escape a Spaniard for an instant, however unlearned he may be. After the second verse of a long string of *asonantes* he discovers the final vowels which govern; he listens at the proper places, and an actor could not with impunity disappoint him: this is a rare quality, owing to the delicate organisation of the people, and to the habit of declamation which the most obscure and vulgar acquire. I leave to my readers to classify the song.

In accordance with what I have stated in regard to the usage coming down from what some would call the olden time of 1847 and 1848, provision is made for excursions to neighbouring forests, and even forests at a considerable distance from the school, being made by the students in company with one or more of the professors—including provision for meeting the expenses of all on such excursions,—and for excursions being made by the professors into the forest lands of other nations for purposes of observation and report.

Of what may thus be done, and has been done, an illustration is supplied by a Report already mentioned, published by official authority, entitled ‘*Memoria Relativa a la Excursion Verificada por los Alumnos de tercer Anno de la Escuela Especial de Ingenieros de Montes a los Montes Publicos, Dunas y Alcornocales de la Provincia de Gerona por el Verano de 1882, Escrita por Don,*

Primitivo Artigas, Ingeniero Jefe de Montes, y Professor de Selvicultura, Meteorologia y Climatologia de la Escuela Especial de Ramo. Publicata con Authorizacion Oficial'—Memoir relative to the Excursions made by the Students of the third year of the School of Forest Engineers to the public forests, dunes, and cork-tree woods of Gerona, in the spring of 1882—written by Don Primitivo Artigas, Chief in the Corps of Forest Engineers, and Professor of Sylviculture, Meteorology, and Climatology in the School of Forestry, and published with official authority.

The report of the tour of observation shows such tours to be made not in a desultory manner, but with some special object to be accomplished, as in this case in fulfilment of a commission given to the Professor, with authority to take students with him to see what he sees, and learn from him what he may consider it of importance that they should know. The tour was made by an order of the Minister of the State, issued on 8th June, 1882, in fulfilment of arrangements sanctioned by Royal order in the May of the preceding year. It was submitted by the Professor to the Council of the School of Forestry, with explanatory statements, and on their recommendation it was published at the expense of the State.

The report, interesting to us chiefly as illustrative of the kinds of objects to which the attention of the students was directed, comprises accounts of Barcelona, of the large manufactory of land and naval engines there, the carpet manufactory, the saw mills, the ships and shipping, and the public park—with lists of trees, shrubs, and interesting herbs, indigenous and exotic, seen there; of the public forest of the province of Gerona; of an inundation which had occurred, and the need there was for an increase in the staff of officials employed. Of Gerona itself accounts are given of the saw mills; of the manufacture of paper pulp; of the public park, and trees and plants seen there; the geology of the district; the institution of secondary education; and the Archæological Museum. There are next

described the pineries of Palafargell; the lighthouse, and the academy. To this succeeds the accounts of the cork-oak, and the cork manufacture, which has been cited [ante p. 114] and of the dunes on the coast; of measures adopted for fixing these, with notices of the climate, and of legal questions relative to the proprietorship of these; a list of 125 articles used or produced in the forestal industry of the district, collected and deposited in the museum of the school; lists comprising 100 specimens of plants, minerals, and rocks, also collected and so deposited; and a *resumé* of the whole, with practical and scientific conclusions arrived at.

Passing next to Torroella de Montgri, accounts are given of the mansion and forest La Fonollera; of the dunes of Bagur; of the invasion of the phylloxera in Ampurdan; of the forest *Montana Gran*, and its management; reasons why the forests of Torella de Montgri should, with other classified State forests, be exempted from sale; of the agricultural productions of the district, with notices of the importance of establishing there a forestal meteorological observatory. To this follows a report of the dunes, which has been reprinted and published in a separate form; in this accounts are given of the dunes of the first, the second, and the third zones; remarks on the fixation of dunes; on the climates of the dunes; opinions relative to the fixation of dunes; a question at law relative to dunes; and there is discussed the question of the appointment of a Commission on dunes, with some account of what has been done in other lands in connection with the fixation of dunes. There follows a catalogue of objects of forestal industries, of plants, of minerals, and of rocks, collected by the students in the course of the tour, and deposited in the School of Forest Engineers in the Escorial. These lists fill eight pages of large 8vo.

In article 23 of the *Reglamenta* of the school is stated: every year one of the professors appointed in turn shall go abroad during the summer, in order personally to see what improvements or additions might be introduced into the

course of instruction followed in the school; and shall embody in a memoir the results of his observation, which, having been submitted to the council of the school, shall be transmitted by them to the Minister de Fomento. And according to article 30 of the *Reglamenta* of the school, when the professors prepare memoirs, lessons, or relative treatises, on matters comprised in the course of instruction, or in the programme of preliminary examination, they are entitled to special grants in remuneration on a proposal to that effect of the *Junta Facultative* of the corps, on the previous report of the professors. The amount of the remuneration is determined by the Government.

Such a tour of observation was made in 1864, by Royal order of the King of Spain, by Sr. Don Maxima Laguna y Villanueva, Forest Engineer in Chief, and Professor in the School of Forestry in the Escorial. The report made by him, published in 1866, by Royal order, treats of the instruction in forest science and practical forestry in Austria in the schools and academies of Mariabrunn, Schemnitz, Weiswasser, Ausee, and Kreul, comparing it with that given in Villaviciosa in Spain; and suggesting certain modifications in this deemed likely to be useful. It discusses also the forest service in Austria, in Bohemia, in Hungary, and in Saxony, together with the instruction in forestry given in Russia, and in the School of Practical Forestry in Lissino, and in those of the Steppes; and the general administration of forests in Russia.

Senor D. Carlos Castel y Clemente, Commander of the Order of Isabel la Catholica, and Chief of the Second Class of the Corps of Forest Engineers, made a tour through Norway and Sweden, and by Royal order the observations submitted by him to the Facultative Junta, or Council of the Corps, were printed in an edition of 600 copies, under the title 'Memoria sobre las condiciones naturales y produccion Agricola y Forestal de la Peninsula Escandinavia.' Under successive chapters there are detailed the geographic condition of the Scandinavian

Peninsula, embracing:—1. The situation, boundaries, and area; the geography, and the hydrography of the land. 2. Factors of production: the soil, climate, and people. 3. The agricultural production, with details of the different botanic regions, and of agriculture. 4. The forests, comprising the mode of tenure by which they are held, and the condition and products of the forests. 5. Forest industries, embracing the transport and sawing up of timber; the fabrication of wood pulp; of charcoal, and of lucifer matches; and other products of the forests.

On the occasion of the International Exhibition in Philadelphia being held in Pennsylvania, again Senor Don José Jordana y Morera, Chief in the Corps of Forest Engineers, author of the 'Catalogue Raisonné of Spanish Works on Forest Science,' of which mention has been made, was sent as a commissioner and director of the agricultural department of Spanish exhibits, and Senor Don Sebastian Vidal y Soler, Chief in the Corps of Forest Engineers in the Phillipine Islands, and official in the order of the royal crown of Prussia, as commissioner from the Minister of foreign affairs, and by them a report was made under the title of 'Apuntes Sobre los Montes, y la Agricultura Norde-Americana, Memoria Elevada al Exmo. Sr. Ministro de Fomento'—Notes on the Forests and Agriculture of North America: a Memoir submitted to the Minister of Agriculture, Public Works, Trade, and Commerce—which was published in 'El Tiempo,' and in the 'Boletin Oficial del Ministerio de la Ultramar'—Foreign affairs; and subsequently reprinted and published for general use.

In this there are given reports of the boundaries, area, orography, hydrography, geology, geognosy, temperature, and rainfall of the territory of the United States; which is followed by a lengthened review of the forestal condition of the country throughout its extent, based on data obtained from the work by Professor Brewer of Yale College, New-haven, and the statistical atlas of General Walker, It



comprises:—1. Prevalent ideas on forestal matters, as advanced by distinguished writers, and by scientific societies. 2. Forestal legislation in regard to the Union and to individual States. 3. Instruction given to officials, and methods of management followed in the existing forests. 4. A forestal sketch of the country, specifying the wooded areas, and the kinds of trees growing. 5. Sylvicultural conditions of such species as might be introduced advantageously into Spain. 6. Forest industries, more especially those connected with the trade in timber, and the exploitation of resinous products; and an account of maps and works and forest products which might be useful in the instruction given in Spain, which they had collected. This is followed by a more condensed review of the agriculture of the United States, in which are tabulated the respective money value of the several agricultural products of the country, and of the different kinds of animals reared and tended; the population of the different States; and the number of bushels of maize raised in each, with the number of bushels of wheat to each inhabitant; the value of cotton raised; the value of the annual production of sugar during the preceding five-and-twenty years in the State of Louisiana and throughout the United States; and in conclusion there are enumerated as deserving of study:—1. Special articles of culture: cereals, roots, forage plants, tobacco, sugar cane, and rice, with the adaptation of the first mentioned three for culture in the Peninsula, and the remainder in the foreign dependencies of the country. 2. Implements, apparatus, and machines for the improvement of culture, and subsequent preparations of the aforementioned, according as the produce is required for the market, or for agricultural reproduction. 3. Systems of breeding and rearing cattle, and the best breeds for draught, and for the production of flesh, wool, milk, and leather. 4. The principal schools of agriculture, and methods of instruction followed in these. 5. Works, maps, and agricultural works of all kinds which might be of benefit for Spain. 6. An agricultural and pastoral sketch of the United States.

In the spring of 1881 there was held in Algiers what in Britain would be called an Agricultural Show, the comprehensive character of which led to considerable importance being attached to it by those living in Northern Africa and elsewhere, who were desirous of becoming acquainted with the agricultural capabilities of Algeria, and the development which these had received. The Government of Spain commissioned again Senor D. José Jordana y Morera, Chief in the Corps of Forest Engineers; Senor D. Alfredo de Madrid Davila, mining engineer; and Senor D. Eduardo de Robles, agricultural engineer, to attend, make their observations, and report. Every facility they could desire was afforded to them by the authorities in Algiers. The Exhibition continued from the 2nd to the 11th of April. On the 14th there was assembled a Congress of Science, which was continued till the 20th; after which several scientific excursions, for which preparations had been made, were undertaken by the members of the Congress. This was attended by the Spanish Commissioners; and these giving their attention chiefly to matters pertaining to agriculture and forestry, availed themselves of the arrangements made to visit, and reconoitre with the greatest extent and precision possible, the Cedar mountains of the Atlas range; the agricultural exploitations of Bouffarik; the fruit cultures of Blida; those of the Huerta of Perreguex; those of the *Secano*, or dry arable land of Sidi Bel Abbas; and the system of irrigations and *pantanos* or reservoirs of the Cuenca, or basin of the Habra.

Their report comprised, with a critical account of the Exhibition, a detailed description of the agricultural and forestal cultures, of the cattle stock, of the fixed property, and, in a word, of everything constituting the territorial strength of that fertile country. It was illustrated by numerous drawings, and accompanied by a detailed account of the excursions and professional visits of inspection made by the several members of the Commission to estates and districts remarkable in connection with some of the

matters interesting to agriculture; with interesting and useful statements of comparisons between the agriculture of Algeria and the agriculture of Spain, and recommendations of innovations by which the productions of Spanish lands might be improved. By the Government it was recognised that the report by the multiplicity of matters which it embraced, and the character of its details, constituted it an excellent agricultural and forestal description of Algeria, such as was not to be found in the Spanish language, if such an account of that country existed in any language; and it was by Royal order published at the expense of the Ministry de Fomento, under the title of 'La produccion Agricola y Forestal de la Argelia en el Concuso de Argel de 1881—The Agricultural and Forestal Productions of Algeria in the Colonial Exhibition in Algiers in 1881. In an introduction is given an account of the country; and there is added a list of the more important of the works, printed books, pamphlets, and periodicals made use of by the Commissioners in the preparation of their report, constituting a valuable bibliography of Algeria. Details are given of agricultural exploitations in different parts of the colony, and of the works of irrigation; descriptions of the cattle, oxen, sheep, and goats; of asses, mules, and horses; of camels, dromedaries, and swift dromedaries, *meharis*; of poultry and domestic animals under acclimation; accounts of machinery, implements, and tools, including hydraulic apparatus, steam engines, and wind-mills; detailed notices of agricultural and forestal products, and industrial manufactures connected with these, including sericulture, apiculture, pisciculture, &c., horticulture, arboriculture, the culture of the eucalyptus, and that of the cork tree, and the collecting of esparto grass; and agricultural and forestal maps of Algeria, including charts of the orange producing region, of that of the vine and the olive, of the zone of the esparto grasses, and of the so-called *mer d'alfa*.

In further illustration of the breadth and comprehensive-

ness of views taken in Spain in regard to what should be done under the provision made in the *Reglamenta* of the school for excursions in foreign lands, such as have been mentioned, I may state that a commission was given in accordance with a Royal order to a member of the Corps of Forest Engineers, Senor D. Joaquin Maria de Castellarnau y de Lleopart, to visit the zoological station at Naples, study proceedings there, and report. This he did in a memoir entitled 'La Estacion Zoologica de Napoles y sus Procedimientos par el Examen Microscopico,' which was presented to the Minister *De Fomento*, the Minister of Agriculture, Trade, and Commerce, and published.

Senor Castellarnau spent at the station the first three months of 1883; and in his memoir he sought to give a definite and correct idea of the station, of the facilities for study afforded by it, and of the importance, and even necessity, which there is for such stations, if zoology is to be made a true science founded on observation; and thereafter to discharge the commission with which he had been entrusted, by describing the methods and special proceedings at the zoological station at Naples, omitting all such generalities, formulas, and modes of operation as may be met with in treatises on the microscope, but narrating some which might not have been previously described.

In the first part is supplied information relative to the necessity, the object, and the importance, of such observatories; the history of this zoological laboratory, in which there are 22 tables, supported by different nations, including one supported by the British association for the advancement of science, where any one nominated by the association may prosecute researches; and two were formerly supported by associations in the United States of America, at one of which a young lady was then engaged in the study of cephalopods;—publications which had appeared communicating the results of observations made; means which had been adopted there and in other countries for the preservation of marine animals; and the aquarium of

the station. And with this information is given a detailed account of the fauna of the Gulf of Naples.

In the second part there is given copious, explicit, and valuable information, such as might be desired and found satisfactory by any parties desirous of establishing a similar institution, or deciding on the expediency of proceeding thither for study of the protozoas, both general and special, and in regard to proceedings followed in the study of marine animals in general: first, proceedings connected with the killing, setting, and preservation of these; and the application made of these to the different classes—protozoas, sponges, and corals, the actinæ or sea anemones, and madrepores, the medusæ, &c., &c., the crustaceæ, the molluscs, and the vertebrates; operations connected with dissection, with colouration, and with making and mounting sections. In an appendix there is given information in regard to photo-micrography; and in each section there is given the bibliography pertaining to the subject.

By the Minister *De Fomento* the report was submitted to the *Junta Facultativa de Montes*, or Forestal Professional Council, in accordance with the regulation cited. By them its publication and distribution among persons and establishments dedicated to the study of natural sciences was cordially recommended. In their report they enlarge on its relating chiefly to study of the aquatic protozoa, but recognise the bearing of a knowledge of the natural history of these on the natural history of all higher organised structures, animal or vegetable; and thus they indicate the comprehensive character of the views entertained by them of what is comprised in forest science.

## CHAPTER VI.

### CORPS OF FOREST ENGINEERS AND STAFF OF TEACHERS.

By the *Revista de Montes* there was published an *Escalafón*, or classified list of the members of the National Corps of Forest Engineers, arranged according to their rank, on the 1st July last (1886).

In an appendix to this it is stated that the title National Corps of Forest Engineers is given to the Association of Engineers, so designated, who have charge of the conservation, replenishing, improvement, and exploitation of the public forests of the kingdom.

By Royal Decree of the 17th of March, 1854, there was created this Corps of Forest Engineers, for the facultative or professional service of the department; and it was arranged by Royal Decree of the 16th March, 1859, that this should be composed of three inspectors-general; fifteen district inspectors; forty chief engineers of first class; fifty chief engineers of second class; sixty engineers of first class; seventy engineers of second class.

According to article 14 of the organic regulations of the Corps, it is obligatory on the Engineers to make use of their distinctive badges in acts of service, and of their uniform in solemnities and public acts in which they are required to take part.

There is also a subaltern service, composed of 25 assistants of first class, and 350 assistants of second class, and of 400 foremen planters, created by the law of 11th July, 1877.

The custody of the public forests is entrusted to the civil guard.

From what is stated in this appendix to the *Fscalafón*, it appears that the School of Forest Engineers at the Escorial is governed by the regulation of 27th October, 1879.

It was in the summer of 1885 that I visited Spain. In the account of the School, which I have given in a preceding chapter, I have stated [ante p. 20]—‘By the Decree of 23rd October, 1868, the prescribed course embraced a period of three years; by the Decree issued under date of 24th October, 1870. it was so extended as to embrace a period of four years; but by a temporary or provisional arrangement it is at present completed in three years.’ And again [ante p. 24]—‘The second period of study embraces four years spent in the School,’ and the studies assigned to each have been detailed. And according to the statement in the appendix to the *Escalafón*, in the re-organisation of the School on the 18th August, 1847, the course of instruction embraced four years. I have never heard of any Royal order, or other act, authorising a change; but it appears from what is subsequently stated here that at present the curriculum extends over five years.

In accordance otherwise with what I have stated, to enter as a student the aspirant must pass an examination in arithmetic, elementary and higher algebra, rectilinear and spherical trigonometry, physics, and the French language; and he must present a certificate of academic examinations in geography, history, Spanish, and Latin, or grammar. The instruction in the School is now distributed thus:—First year, descriptive geometry, differential and integral calculus, theoretic mechanics, and general chemistry. Second year, topography, applied mechanics, zoology, and applied chemistry. Third year, botany, mineralogy, geology, and geodesy. Fourth year, sylviculture, meteorology, and climatology, administrative justice, and legislation relative to forests. Fifth year, *ordenacion* of forests and xilometry, forestal industries, and political and forestal economy; and throughout all the years of study there is continuous instruction in drawing.

Having concluded their studies, and spent some time in practical work in a forestal district, the students then receive the appointment of forest engineer.

The salaries of the six grades of forest engineers are respectively 12,500, 10,000, 7,500, 6,500, 5000, and 4000 pesetas or francs. In field work the inspectors have also an allowance of 25 francs a day; chief engineers one of 20 francs; engineers of first class and second class one of 15 francs or pesetas.

Spain is divided into 46 forestal districts; three less than the number of provinces and departments. The forests in each of these are under the charge of a Chief Engineer. Besides the forestal district court there is a *Junta Facultativa*, or Professional Council, composed of eighteen inspectors; the Commission of forestal flora; that of a forestal map, and another of the catalogue of forests reserved from alienation; one of replenishing exhausted forests; and one of the Sierra de Guadarama.

For conducting the studies in the School there are appointed a Director, who is head of the school; ten professors of the corps of engineers; two assistants, who must also be engineers; and to these are joined the following subordinates:—a collector, preparer, and conservator of objects of natural history; an official assistant secretary; an official assistant librarian; two clerks; a steward; a resident in charge of the school forest; a porter; three servitors; necessary warders and sub-warders for the protection of the land and mountains appropriated to the service of the school; and labourers and peasants required for work on the same.

The professors, previous to appointment, must each have completed five years of active service in the Corps of Forest Engineers; the assistant professors must have completed two years of such service; and of the Director of the School it is required that he must have attained to the position of an Inspector in the corps.

They all continue to receive the salary attached to their



positions in the service, and with this an annual allowance determined by the Government, with a definite increase at the termination of every period of five years service, continued annually during the next period, the successive augmentations being equal in amount to half the allowance made during the first five years; and should the requirements of the service at any time interrupt the discharge of the duties of the professorship, either during the currency of one quinquennial period or between two, as may happen, this takes place without detriment to the right acquired by previous service in the School; and the Director of the School receives in addition to his salary, as Inspector of Forests, an allowance determined by the Government, in accordance with the same rule as to increase.

Of the officials, the Director and the janitor alone reside in the school buildings.

From the Budget of the Minister *De Fomento* for 1881-1882, the latest to which I had access, it appears that at that time the gratuity to the director was 2000 pesetas; to one professor, a member of the Corps, 2000; to ten professors, 1500 = 15,000; to two assistant professors, 1500 = 3000; to the collector, preparer, and conservator of objects of natural history, were paid 2000, and as a gratuity to the same for special work, 250; to the secretary, a salary of 1500, and a gratuity for special work, 750 [*sic*] 1750; second secretary, 1250; and to a consierge, 1500; a porter, 1000; three lads, 750 each = 2250; an overseer of the *campo forestal*, 1000; a watchman of this, 750: in all, 33,750 pesetas.

To this has to be added the expense of the establishment, which is given as: maintenance of the school buildings, 500 pesetas; expenses of the secretariat, 500; the *campo forestal*, labour, cultivation, plantations, and tools, 2000; three day labourers at 1.50 of days' wage, 821; library and collections in the museum, 1000—in all, 4,821: together, 38,750 pesetas or francs.

As has been intimated, the allowance to the Director and to the professors is in addition to the salaries which

they draw as members of the Corps of Forest Engineers, which varies with their rank in the service, hence it is designated *gratificacion*, allowance, or gratuity.

The instruction is given (1) by oral lectures and lessons in drawing by the professors; (2) by written exercises, calculations, and analyses on the subjects embraced by these lectures; (3) by the detailed study of the animals, rocks, plants, and forest products preserved in the collections and adjuncts of the establishment; (4) by the practice of topography, land surveying, the study of natural history and orography in the field; (5) by excursions to the plantations and mountains.

The school sessions extend, with specified holidays, from the 1st of October of one year to the 31st of May in the year following. Field exercises are included in this session, but according to what may be required in different classes these may be extended over the months of June, July, and August.

The material provisions for study, as has been intimated, consist of the buildings, lands, forests, nurseries, gardens, and their dependencies, appropriated to the school; the meteorological observatory; the furniture of the institution, a library and collections of charts and drawings; a laboratory and cabinet of chemistry, with apparatus and reagents; collections and museums of topography, land surveying, and cabinets of illustrations of natural history, of mountains, of mechanics, and of forest industries; the collection of iron implements employed in the practical working of the school lands or in the studies of the pupils; herbaria and collections of plants and of fruits; and in conclusion, the workshops and machinery, with all the iron tools belonging to these, and the equipments and arms of the warders and dependents.

The students do not live in the school; but each is required to lodge his address with the secretary of the school, and to keep him informed of any change of residence made by him. They are required to supply themselves with all text-books, mathematical instruments, writing and drawing

implements, and the uniform prescribed to the students ; but beyond this I know of no pecuniary charge made upon them. Regular and punctual attendance, studious attention, and respectful and orderly behaviour are enjoined.

Occasional absence, even with consent of the instructor, want of punctuality, inattention, &c., are punished by deductions from the numerical value attached to the attendance required in order to obtain a diploma at the close of the course ; disobedience, insubordination, &c., are punished by expulsion, or suspension till the decision of the Government is obtained.

They are not required to have previously engaged in work of practical forestry ; but, as has been intimated, there is provision for this being done where it may be desired, and for excursions being made to forests, under the guidance of one or other of the professors, in the course of the curriculum. On these excursions their travelling expenses are met from the funds of the school, with an allowance of 10 reals, or about 2s a day, and the professor in charge has an allowance of 25 reals, a little more than 5s, for provisions.

## PART II.

### PRACTICABLE ARRANGEMENTS IN ACCORDANCE WITH THOSE IN THE SCHOOL OF FOREST ENGINEERS IN SPAIN, SUITABLE FOR A BRITISH NATIONAL SCHOOL OF FORESTRY.

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IN the session of the British Parliament in 1886, a Select Committee of the House of Commons was appointed to consider whether, by the establishment of a School of Forestry, or otherwise, our woodlands could be rendered more productive. Before this I was called to give evidence in regard to the constitution of Schools of Forestry; when I stated, amongst other things, in reply to successive queries, in substance that there was no one School of Forestry on the Continent of Europe which I could propose as a model for a British National School of Forestry, if such should be organised; nor one which I could recommend as a type; but that I considered the School of Forest Engineers in Spain one organised after a type which it might be advantageous to follow, in organising any such School in Britain for the training of officials to administer and manage extensive forests in our colonial possessions, and other similarly conditioned countries.

One difference which may be remarked in the School of Forest Engineers in the Escorial, and others in Central and Northern Europe, is that while these generally are in accordance with a system of graded schools there existing and are adapted to a forestal condition of the country, similar, if not identical, in all of them; that in the Escorial is, to a considerable extent, indepen-

dent of any such organised school system, and is designed to meet the requirements of a state of things considerably different from that which exists in these other lands; and this is a state of things very similar to what I have seen at the Cape of Good Hope, and what I have reason to believe to be existant in others of our Colonies.

It is in view of this that I cited it, not as a model, or as a type to which it is expedient that a National School of Forestry in Britain should be conformed; but as illustrative of the category of schools of forestry, which are desirable amongst the English speaking nations, and Colonies in which modern forest science and appliances might, in accordance with national school organisations, be adapted to meet national requirements. This has been done efficiently in Spain; and I am persuaded that *mutatis mutandis* it might be done in Britain, and other lands similarly conditioned. Under this impression I proceed to discuss some of the facilities presented in our country for the execution of such an enterprise; bringing under consideration those which relate to an appropriate site; those which relate to scholastic arrangements adapted to the site recommended—including conditions, curriculum of study, and expense—and those which relate to the creation of forest literature, similar to the modern forest literature of the Continent.

## CHAPTER I.

### APPROPRIATE SITE FOR A BRITISH NATIONAL SCHOOL OF FORESTRY.

THE selection of a site for a National School of Forestry is a matter of considerable importance. The original idea, or one at least which was entertained at a very early period in the considerations of arrangements to be made for the establishment of a School of Forest Engineers in Spain, was that the school should be established in the capital. Difficulties experienced in securing suitable house accommodation for the school in Madrid proved almost fatal to the scheme. To cite the phraseology made use of, it had become a question of *To be or not to be?* when the discovery was made that suitable accommodation might be obtained at Villaviciosa; and subsequently the discovery was made that, all things being considered, still more suitable accommodation might be found in the Escorial: and thus was determined the sites successively adopted. Both of these sites were, by what seems like a legal fiction, considered to be covered by the phraseology employed in the Royal Decree, which required it to be located in the vicinity of the Court, by which was meant, in the capital.

These locations successively commanded the assent of His Excellency Senor D. Maximo Laguna y Villanueva, by whom, after making himself acquainted with the conditions of Schools of Forestry elsewhere, the location of the school in Madrid had been advocated; and the assent of His Excellency Senor D. Bernardo de la Torre Royas, by whom the school at Villaviciosa had been organised; but the original design was that indicated, that the school should be located in the capital, and this was desired because of the educational advantages which could be commanded there.

In giving evidence before the Select Committee of the House of Commons, I stated in reply to a query put that Edinburgh affords special advantages, and such as are unequalled elsewhere, for the site of a National School of Forestry.

Among the more manifest advantages of Edinburgh as a site for a National School of Forestry may be mentioned the following:—Adjacent to the city is an Arboretum purchased by the inhabitants at an expense, it is said, of £20,000, and presented to the nation in the hope that it might be utilized for the study of forestry. Conterminous with this, and connected with it, there is a large well-equipped and well-stocked Botanic Garden, supported by the nation. In this there is a large comprehensive museum of all kinds of vegetable products.

In the Museum of Science and Art, maintained by the Committee of Council on Education, in close proximity to the University buildings, there is already a large and valuable collection of woods and other forest products, and well-selected specimens of illustrations of mineralogy and geology, of entomology, ornithology, and zoology; and in the report of this Museum for 1884 it is stated:— ‘Considerable additions have accrued to the forestry section of the Museum from the International Forestry Exhibition which was held in the city during the last year. The whole of the Johore collection of forest products have been presented by His Highness the Maharajah of Johore, G.C.M.G., K.C.S.I., &c. A large portion of the extensive Indian collections has been received from Her Majesty’s Minister of State for India, and an extensive selection of the products of British Guiana, Sierra Leone, Gambia, and St. Vincent, has been given by the Commissioner in charge, the Hon. William Russel. From the Japanese Commissioners to the International Health Exhibition, Messrs Tegima and Nagai, interesting collections of educational objects and food products have also been received.’ Nearly three thousand articles were thus added to the Museum. Corresponding collections of articles from

the International Exhibition, placed at the disposal of a Committee appointed to take measures for the establishment of a permanent Museum of forest products, have been transferred to this Museum by that Committee; and along with these, according to a report made to that Committee, a large collection accumulated during many years by the Scottish Arboricultural Society, all to be arranged for exhibition, so soon as contemplated additions to the building are made.

There are numerous nurseries in the immediate vicinity of the city, and well-kept woods and plantations of easy access. There is an Arboricultural Society, a Botanical Society, and a Field-Naturalist Club, to the membership of all of which it is presumable students of forestry might be eligible. Thither gravitated the publication of *Forestry, a Journal of Forestry and Estate Management*; and there are resident the gentlemen with whom originated the idea, and by whom were carried out the arrangements for the International Forestry Exhibition, and those who, from their known interest in the enterprise, have been commissioned to endeavour to secure the establishment there of a National School of Forestry. And there are situated the headquarters of the Highland and Agricultural Society empowered to grant certificates of attainments in knowledge of forestry.

In the University are taught the following subjects, by professors whose names are annexed:—*Mathematics*—Prof. Chrystal; *Natural Philosophy*—Dr Tait; *Chemistry*—Dr C. Brown; *Agriculture*—Prof. Wallace; *Botany*—Dr Dickson; *Geology and Mineralogy*—Dr Geikie; *Natural History*—Dr J. C. Ewart; *Engineering*—Prof. Armstrong; *Commercial and Political Economy and Mercantile Law*—Prof. Nicolson; *Conveyancing*—Dr J. S. Tytler; *Anatomy*—Prof. Turner; *Surgery*—Prof. Chiene. In summer, tutorial classes for the study of Mathematics and Natural Philosophy are conducted by the assistants of the professors of those subjects, for students who have attended a winter course therein.



And means are afforded for practical instruction during winter and summer in the following subjects:—Practical Chemistry, under the superintendence of Prof. Crum Brown; Practical Physiology, under the superintendence of Prof. Rutherford; work in Physical Laboratory, under the superintendence of Prof. Tait; work in Natural History Laboratory, under the superintendence of Prof. Ewart; and in Herbarium and Botanical Museum, under the superintendence of Prof. Dickson. During winter—Bandaging and Surgical Appliances, under the superintendence of Prof. Chiene; work in Mineralogical and Geological Laboratory and Museum, under the superintendence of Prof. Geikie. In the summer—Practical Botany, by Prof. Dickson; Vegetable Histology, by Prof. Dickson; Practical Natural History, by Prof. Ewart.

In the Watt Institution and School of Arts provision is made for the instruction of classes in Chemistry Theoretical and Practical, Natural Philosophy, Mathematics, Arithmetic, Engineering, Architectural, Mechanical, Geometrical, and Machine Drawing, Sanitation, English Language and Literature, History, Animal Physiology, French, German, Agriculture, Botany, Geology, Biology, Freehand Drawing, Bookkeeping, and Writing.

With such provision for preparatory and accessory instruction, all that is further required is provision for professional studies. These may be classed under the following heads:—

#### Part I.—

Forest botany, embracing the structure, physiology, scientific classification, and natural history of herbs found in woods, and arborescent shrubs and trees.

Forest Pathology, or diseases, and the natural decay and death of trees.

Forest Mycology, or natural history of fungi found in forests, and of fungi injurious to trees and timber.

Forest Entomology, or natural history of insects injurious to forest products.

Forest Ornithology, treating of birds injurious or beneficial to the forests.

Forest Mazology, treating of quadrupeds, &c., injurious to forests.

Part II.—

Destruction of Forests by Man.

Forest Conservation in France and in Germany.

History of Forestry.

Advanced Modern Forest Economy.

Sylviculture in accordance with the Advanced Modern Forest Economy.

Forestry of different Countries on the Continent of Europe.

Forestry and Arboriculture of Britain.

Improved Forestry in India.

Treatment of Forests in British Colonies.

Destruction, Conservation, and Extension of Forests in the United States of America.

With many, the proximity of a forest in which students may be familiarised with practical work, is considered necessary to the efficiency of a School of Forestry in Britain. Such an adjunct has not been found necessary in Spain; but no one will deny that it might be advantageous to any School of Forestry to have such an adjunct.

In the number of the *Journal of Forestry* for December, 1880, reference is made (p. 496) to the proprietor of an estate in Midlothian being willing to feu to the Government, at a low rate, a highly eligible and conveniently situated piece of land, stretching from the environs of Edinburgh to the top of the Pentland Hills, for experimental purposes in arboriculture, agriculture, and horticulture. It is stated that the land in question comprises a great diversity of soils and aspects, suitable for the growth and cultivation of all kinds of trees, and a burn, or watercourse, which affords a plentiful supply of water,

and which could easily be made to form a highly attractive as well as useful object in the landscape. It is stated, further, that it presents a considerable range of altitude, rising from about 200 feet above the level of the sea to a height of about 1,600 feet.

In some of the Schools of Forestry on the Continent the students remove with their teachers to some forest at a distance in spring, and spend the summer in practical work. I do not suppose that any difficulty would be experienced in finding foresters of established reputation willing to supply practical instruction in the forests under their charge to students who were able to avail themselves of such an advantage; nor is it impossible that satisfactory arrangements might be made for such practical training being obtained in some of the Crown forests in England.

By Mr Mackenzie, superintendent of Epping Forest under the Corporation of the City of London, there was submitted to the Epping Forest Committee of the Court of Common Council in 1881, a memorial, in which he unfolded a scheme for the establishment of a School of Forestry in connection with that forest. There appears to be little probability of effect being given to his suggestion; but there is one point in regard to which he makes some important statements, of which advantage might be taken in endeavours to secure practical training for students who have no access to forests in Scotland in which to gain a knowledge of the practical work in which they desire to engage.

Writing to the Epping Forest Committee of the London Court of Common Council, he says: 'You possess about 6000 acres of land all more or less forest, neglected, detached, and inharmonious in effect by reason of its having been, from circumstances well known to you all, so very much subdivided, that an effort must be made, as soon as the outlying portions are restored to your care, to blend them all into one harmonious, albiet diversified, whole; consequently the land must be carefully surveyed, and mapped out accurately, in order that a reliable plan

may be obtained on which to work out a scheme which may guide the conservators of the forest for all time ; and lastly, that much planting, and the careful thinning and pruning of existing trees, must be judiciously prosecuted for many years.' It is added : 'The execution of all these works would form the best possible groundwork for the practical training of the foresters in the future.' And in the programme of study which he submits, he says : 'If the course of study should extend over four years, the first two to be spent at Epping Forest, where the trees have been neglected for so many years, it will be the object of the staff to organise order, and produce regularity out of disorder and chaos ; the third year should be spent in the New Forest, which is a tract of sufficient extent, having over 60,000 acres, and which, having been in Government keeping, may be supposed to be a farther advance and development of the principles pursued by the student during his first two years at Epping ; the fourth year should be spent at Windsor, where may be seen the full development of the principles commenced by the student at Epping. After this course of training, those pupils who have diligently applied themselves to their studies during the four years should be drafted off to other fields of usefulness, either at home or abroad.'

Should it be deemed desirable, as I think it is, that provision be made for still higher or more varied training being given to a select number of the more promising students, the desideratum can be met. In more than one of the most celebrated Schools of Forestry on the Continent, provision is made for the attendance of foreigners, and these enjoy all the educational advantages of the alumni on specified terms. Assuming that the teacher of Botany—if there be but one—or one of them, if there be more, be qualified by knowledge of the language spoken, such advanced students might be sent under his direction to attend at one of these Continental Forest Schools for a summer session ; and possibly permission might be obtained from the same or some other School of

Forestry for the British students to accompany the students of that country on their autumnal excursion, and to take part with them in the forest work, to the great advantage of teacher and taught, and through them to that of the country at large.

## CHAPTER II.

### SCHOLASTIC ARRANGEMENTS.

#### SECTION 1.—CONDITIONS.

SUPPOSING Edinburgh selected as the site of a National School of Forestry, there are four practical arrangements by any one of which the advantages derived from this selection might be secured at a moderate expense:—1. The creation of a Professorship of Forestry or Forest Science in the University. 2. The creation of a Lectureship on Forest Science in the Watt Institute. 3. The creation of such a Lectureship in connection with the Royal Highland and Agricultural Society of Scotland. 4. The creation by the Science and Art Department of the Committee of Council on Education of a School of Forestry in Edinburgh, resembling the Royal School of Science in Dublin, and the Royal School of Mines and Practical Geology in London.

In the Normal School of Science, and Royal School of Mines and Practical Geology in London, under the Science and Art Department of the Committee of Council on Education, instruction was given in the winter session 1883-84, the latest of which I have a report, in chemistry, physics, mechanics, &c, mathematics, geology, and mineralogy, biology, botany, metallurgy, mining, agriculture, and astronomy. In the summer course of 1884 instruction was given to students in chemistry, mechanics including mechanical drawing, heat, metallurgy, hygiene, and agriculture; and lectures were given to working men in mineralogy, mechanics, and chemistry.

In the Royal College of Science in Dublin, under the Science and Art Department of the Committee of Council

on Education, instruction was given in the same session, (1883-84), to students of the first year in pure mathematics, elementary mechanics, descriptive geometry with lessons in geometrical drawing, theoretical chemistry, and experimental physics. To students of the second year instruction was given in pure mathematics, general mechanics, mechanical drawing, practical physics, practical chemistry, biology, and mineralogy. To students of the third year instruction was given in mechanism and thermo-dynamics, applied mechanics and hydro-dynamics, engineering, drawing, surveying, geology, palæontology, mining, metallurgy, applied chemistry, assaying and analytical chemistry; and there were special courses of instruction given in botany and practical botany, and in zoology and practical zoology.

The total number of individuals who attended the stated lectures was eighty, of whom twenty-nine were associates, students prosecuting the whole three years' course with a view of obtaining the diploma of associate. The corresponding numbers in the preceding year were fifty-nine and twenty-one respectively.

While England and Ireland have such institutions under the Science and Art Department of the Committee of Council on Education, Scotland has none. But it has under that department of the Government exceptional facilities for the organisation of a School of Forestry on the lines I have suggested. In the Museum of Science and Art, which is under their direction, there is, as has been intimated, a valuable collection of forest products, enriched by a contribution of well-nigh 3000 articles obtained from the Forestry Exhibition, enriched also with those placed at the disposal of the Committee appointed by the Conference held at the close of that Exhibition, and according to credible report, to be further enriched with the copious and valuable collection of the Scottish Arboricultural Society, making it probably the most comprehensive and extensive collection of such articles in Britain, if not in Europe or in the world; and in

the same Museum are well-selected illustrations of entomology and other departments of zoology, of mineralogy and geology, &c. And adjacent to the Museum is the Watt Institute, receiving grants from the Department, reported in 1885, amounting to £179, where it may be assumed accommodation for classes might be obtained, and where, as in the University, contiguous to the Museum, accessory studies might be pursued.

By the nearest possible approximation to unanimity, the Committee appointed at a meeting held in the International Forestry Exhibition in Edinburgh to consider the means necessary to the establishment of a School of Forestry in that city, have advocated in preference to the organization of classes for the study of Forestry in Edinburgh by the Science and Art Department of the Committee of Council on Education, the establishment of a Professorship of Forestry in the University.\*

Amongst other advantages of such an arrangement, the expense—subject to the disadvantage of not having a number of teachers of equal rank in many departments of forest science and of forest economy which it is expedient should be comprised in the curriculum of study, would be very much less; and this being determined there would be little probability of its being subsequently increased, unless the advantage of this should become manifest. There would be secured for the study, and for successful students, a prestige which might operate favourably both in securing students able to meet the expense of University instruction, and in securing the services of teachers of higher grade than might be found willing to undertake the work in connection with the more extensive arrangements which have been under

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\* The following are the names of the members of that Committee:—The Most Hon. The Marquis of Lothian, K.T., President; The Right Hon. Thomas Clark, Lord Provost of Edinburgh; Sir William Muir, K.C.S.I., Principal of the University of Edinburgh; Alexander Dickson, Esq. of Hartree, M.D., Professor of Botany, Edinburgh; Colonel Murdoch Smith, R.E., Director of Edinburgh Museum of Science and Art; Sir Alexander Christison, Bart., M.D.; Robert Hutchison, Esq. of Carlowrie; P. Neill Fraser, Esq.; J. Croumbie Brown, LL.D.; Hugh Cleghorn, Esq. of Stravithie, M.D.; Malcolm Dunn, Esq.; W. A. Belfrage, Esq., C.E. Colonel Dods, Convener.



consideration, and arrangements might be made for the students graduating in the University.

At a meeting of the Council of the Edinburgh University held in the month of July last (1886), on consideration of a communication from the Senatus as to the proposed rules for graduation in science in the Department of Agriculture, the draft of a resolution embodying the proposed rules was approved, and it was ordered that it should be submitted to the General Council of the University at their next meeting for their consideration, in terms of sec. xii. (2) of the Universities (Scotland) Act, 1858. It was also ordered that any communication which might be received on the subject from the directors of the Highland and Agricultural Society of Scotland should be transmitted to the General Council for consideration in connection with the proposed rules. The following is a copy of the proposed rules :—

1. In the Department of Agriculture the degree of Bachelor of Science shall be the only degree conferred.
2. The rules as to a preliminary examination on subjects of general education shall be the same as those for graduation in the Department of Physical and Natural Science.
3. The rules as to attendance on qualifying classes for three sessions shall be the same as those for graduation in the Department of Physical and Natural Science; provided always that instead of one of such three years of attendance, a year may be spent on a farm or farms, in pursuance of the practical study of agriculture.
4. Each candidate must produce a certificate of attendance upon a qualifying class on each subject of examination, if that subject is taught in the University; and if the subject be not taught in the University, he must produce a certificate of attendance on lectures on that subject, at an institution recognised by the University for the purpose; and should he, instead of one of the three years of attendance required in section 3, have spent a year in the practical study of agriculture, he must produce a certificate to that effect.
5. There shall be two

examinations for the degree of Bachelor of Science in the Department of Agriculture. These examinations shall be written, oral, and practical. 6. The first examination shall be in—(1) Agriculture, to such extent as may from time to time be fixed by the Senatus; (2) Chemistry, to the extent required for the first examination for the corresponding degree in the Department of Physical and Natural Science; (3) Engineering, with special reference to field work and draining; (4) Biology, (a) botany or (b) natural history—either subject at the option of each candidate. In either case the examination shall be to the extent required for the first examination for the corresponding degree in the Department of Physical and Natural Science. 7. Candidates who have passed the first examination may present themselves at the end of six months for the second examination. 8. The second examination shall be in—(1) Agriculture, the whole subject; (2) Chemistry, as applied to agriculture; (3) Geology, in so far as bearing on agricultural science; (4) Veterinary hygiene, to such an extent as may from time to time be fixed by the Senatus. 9. Candidates who have passed the second examination shall be recommended to the Senatus for the degree of Bachelor of Science. 10. The examinations shall be conducted by University examiners appointed by the University Court, and an additional examiner in agriculture, to be appointed by the University Court, after communicating with the Council on Education of the Highland and Agricultural Society of Scotland, and considering any recommendation by them. 11. The fees for the degree of Bachelor of Science in the Department of Agriculture shall be—(1) For the preliminary examination, or for registration of any exempting qualification, £1 1s; (2) for the first Bachelor of Science examination, £2 2s; (3) for the second Bachelor of Science examination, £2 2s = £5 5s.'

On consideration of a minute of Senatus, it was resolved to recognise the University College of South Wales and Monmouthshire as one of the institutions at which two of

the three academic years of study of candidates for the degree of Bachelor of Science may be passed.

It seems reasonable to suppose that in the event of a Professorship of Forestry or of Forest Science being established in the University, similar arrangements might be made for students passing satisfactorily through this class, being also allowed to graduate in science.

In conjunction with such arrangements, or irrespective of them, arrangements might be made for the study of forestry being pursued in the Watt Institute.

The advantages of such an arrangement, amongst others, would be these:—It is a popular institution of comprehensive technological study, many of the classes of which might be made subservient to the study of forestry by students giving their attention to this; and such a degree of completeness might be thus given to a prescribed programme of forestal studies that, without detriment to any other course of studies followed there in some of the same classes, a fully equipped School of Forestry might be represented as one of the constituent parts of the institution. It would allow of expansion being easily given, temporarily or permanently, to the course of study in forestry, if this should at any time be deemed expedient, or of contraction or change in this, if such should appear advisable; and that without requiring radical or fundamental change, or such modification as would justify captious censorious remark.

The fees charged, if in accordance with the fees charged in the other classes, would be such as might be met without difficulty by students of limited means; while the hours of study, if like those of other classes, being in the evening, would suit the convenience of those who are engaged in daily labour; and others, who, from any cause, might prefer studying accessory subjects in the course of the day in the University, which is adjacent, would have the opportunity of doing so,—while the proximity of the Museum of Science and Art, with its invaluable collection

of forest products, &c., would give every facility for the study of these.

From what has been communicated to me, on what I consider good authority, students at the Watt Institute, whatever their skill and attainments might be, would not, according to existing arrangements, be eligible for admission into the forest service of India, which is at present the only very eligible career open to educated foresters; but I have no doubt that students, trained as they might be in classes in the Watt Institute, would prove themselves the equals in every respect but that of social position, of those in that service who have studied in Nancy; that when this came to be seen, and recognised as a fact, their services would be in demand for even the Indian service; that whether they were admitted to the Indian service or not, they would soon in India, or elsewhere, create their own prestige; and other students succeeding them, if such arrangements be carried out, would reap the benefit of this, and the School would rise in favour. On these points I have no misgiving or doubt.

Failing all of these plans whereby might be established a National School of Forestry in Edinburgh, or meanwhile until the necessity or the importance of something of the kind indicated being done, permanent or provisional arrangements might with advantage be made by existing organisations, or by private enterprise, to organise arrangements for the study of forestry there. The latter was what was contemplated by the Committee of which mention has been made as having been appointed at a meeting held in the International Forestry Exhibition, and it was only when they found that they could not obtain the requisite funds that they resolved to advocate the establishment of a Professorship in the University.

As has been intimated, a large collection of implements, specimens of wood, seeds, fibres, &c., was, at the close of the Exhibition, placed at the disposal of this Committee for use in connection with a proposed School of

Forestry. In a circular which they issued under date of 28th January, 1885, the Committee intimated that they felt difficulty in suggesting a definite scheme for the organisation of the School until they had some knowledge of the amount of funds which might be placed at their disposal; but that they contemplated the establishment of a Professorship of Forest Science for the instruction of students in all that pertains to practical and to scientific forestry, including the physiology and pathology of trees, the climatic and other effects produced by forests, the different methods of forest management in use in this and other lands, the economic uses to which forest products have been, or may be applied, and forest engineering and forest administration generally: the instruction being communicated by lectures, examinations, written and oral, excursions, &c. And should their funds permit, that the large collection of forest implements, produce, and specimens of various kinds illustrative of forest science and forest economy, with such additions as from time to time might be available, should be placed in a permanent museum in connection with the contemplated School of Forestry; for the accomplishment of all of which they considered £10,000 would be requisite.

In the end of 1885 it was found that a mercantile establishment, in which free storage had been generously given for the large collection of articles placed at their disposal, required the premises in which these were stored. In these circumstances the Committee deemed it expedient to make over the whole to the Museum of Science and Art, in which, along with others which have been procured, they may be permanently exhibited, so soon as the necessary accommodation for this can be provided; and the subscriptions placed at their disposal, amounting only to £660, they resolved to advocate the establishment of a Professorship of Forestry in the University.

Should their original design be carried out by any, in so far as it related to study and instruction, whether this were done by private enterprise or by some one or other

of existing organisations, such as the Royal Highland and Agricultural Society of Scotland, or the Scottish Arboricultural Society, this would give an opportunity of seeing, and of showing, what can be done with even limited means; and by inference, what might be done with greater or better means at command; and it would afford opportunities for experimenting, and so preparing for the perfecting of a scheme, which, placed on a more satisfactory basis, might achieve all that is desired. It is possible that the insecurity in regard to continuance attaching to such arrangements, together with the absence of prestige, might have a prejudicial effect on the supply both of teachers and of students; but even should it prove only a temporary arrangement, it might, in the absence of something more commanding in promise and in effect, do much good.

## SECTION 2.—CURRICULUM OF STUDY.

I do not happen to know of a more eligible site for a British National School of Forestry than Edinburgh would be; and in proceeding to bring under consideration what I consider suitable curriculum of study for adoption, I assume hypothetically that others will feel with me that such is the case.

This assumed, it is requisite to the satisfactory projection of a programme of instruction to know something of the object to be kept in view; of the teachers to be employed—their number and their qualifications; and of the students who are to study there—their capabilities and the time they can give to their studies.

If the sole object aimed at be to impart the instruction necessary for the satisfactory management of woods and plantations in Britain, or for the satisfactory management of forests and plantations in India, or in one or another, or more—in any or all of our colonies, the curriculum might properly be determined by the circumstance of which

one of these objects was to be the object aimed at ; but as at comparatively little additional expenditure of teaching power and of money, there could be imparted the instruction which is required in common by all of these, together with much beside, which might be advantageous, in every way, this is what is desirable in a British National School of Forestry, and what alone would render any School worthy of such a name.

With this point settled, there arises the question of the number and qualification of the teachers to be employed, and the question, Where may qualified teachers of forestry and forest science be looked for with some hope of their being found ?

There are three qualifications which I deemed desirable, if not requisite, in teachers in a School of Forestry—the necessary knowledge ; power of communicating to others the knowledge which it is desired they should impart ; and aptitude for teaching. It may be necessary in the commencement of a School of Forestry to abandon the hope of securing in a teacher or teachers, otherwise eligible, one or more of these qualifications, whether it be determined to organise a school in a fully equipped condition, or one in what may be called an embryotic form. Which should be sacrificed may depend on circumstances too varied to be specified.

Subject to this caveat I may mention that in the Plea for the organisation of a School of Forestry in connection with the Arboretum in Edinburgh, issued by me in 1877, I stated :—

‘The laying out of such grounds can be executed only by a professional forester. But thereafter it may be open to question whether the curatorship of them should be entrusted to a practical or to a scientific officer, and if the latter should be resolved on, there is provision made for the experiment of introducing the study of forest science at little additional expense.

‘I presume if this were done, and if it were extensively

made known that this was the case : that there was an Arboretum, about 30 acres in extent, adjoining the Botanic Gardens and Experimental Gardens, in extent some 20 acres more, with a view described "as one of the most magnificent views of Edinburgh which could be obtained," and "as one of the finest in Europe, including as it did the northern portion of the city, with its spires and domes, and the outstanding eminences of the Castle, Calton Hill, Salisbury Crags, and Arthur's Seat," and that related studies could be carried on under such men as Sir Wyville Thomson, and Professors Balfour, Kelland, Tait, Jenkin, Wilson, Geikie, Hodgson, Stuart Tytler, and Alexander Crum Brown, with such assistants as they have, and such men as are gathered around Dr Stevenson Macadam and Mr Lees in the Watt Institution, there will be no lack of candidates for the work.

'I consider that there must be many of the officers of the Forest Service in India well fitted, by previous training and experience, for conducting such a course of study as I have proposed. Failing this, there might be found, by correspondence with students of forestry on the Continent, able men who might be willing to master the English language and give lectures on some or all of the subjects I have enumerated.

'I have, for some years, myself been engaged in the compilation of information on subjects connected with Economic Botany, with a view to this being, if not previously printed, or otherwise used, deposited in manuscript in the Public Library, Cape Town, Cape of Good Hope, for consultation by scientific and practical men seeking to develop the vegetable resources and the agricultural capabilities of that colony; and I have ready, compiled and translated, all the material requisite for such courses of lectures on Forest Science as I have spoken of. If other duties permitted, I should esteem it an honour, as any man might do, to be entrusted with an opportunity of testing the practicability of establishing a British School of Forestry in connection with the proposed Arboretum;



and from this I conclude, that no difficulty need be anticipated in procuring teachers, if only the necessary arrangements for the teaching were made.

This speaks of the past, not of the present; but as I felt then, many, I doubt not, will feel now, or as soon as measures may be matured for the opening of the School, I anticipate a plethora, and not a lack of candidates.

In order to the projection of a satisfactory programme of study, it is necessary to know something of the attainments and other qualifications of the teacher or teachers whose services can be obtained.

But beyond this there are to be taken into account the number and capabilities of the students, the period over which the curriculum is to extend, and the number of hours which the students can daily spend in class studies.

In lack of all these data it is impossible to speak with the precision which might otherwise have been practicable: they are important, but they are as yet unknown qualities.

With these unknown, I may state that in the Plea for the establishment of a School of Forestry in connection with the Arboretum in Edinburgh, which I issued in 1877, I submitted the following, as what I deemed at that time practicable and suitable; mentioning that I still deem them so.

‘Since my return to Europe, some ten years ago, from the Cape of Good Hope, where I held the appointments of Colonial Botanist and Professor of Botany in the South African College, I have, with the exception of a brief period, been in constant communication, personal and epistolary, with professors and students of forest science, and officials entrusted with the management or administration of forests in Britain, on the Continent of Europe, in the United States of America, in the British Colonies, and in India, having in the course of that time visited the United States a second time, and travelled extensively in France, Bavaria, Austria, Russia, Finland, Prussia, and

Belgium, to obtain and to verify information otherwise obtained in regard to forest economy and forest science. And I submit for your consideration the opinion that, with the acquisition of this Arboretum, and with the existing arrangements for study in the University of Edinburgh, and in the Watt Institution and School of Arts, there are required only facilities for the study of what is known on the Continent as Forest Science to enable these Institutions conjointly, or either of them with the help of the other, to take a place amongst the most completely equipped Schools of Forestry in Europe, and to undertake the training of foresters for the discharge of such duties as are now required of them in India, in our Colonies, and at home.

‘I have before me the *Programme de l'enseignement à L'Ecole Forestiere*, at Nancy, and the official Report of the prescribed studies in the *Central-forstlehr-Anstalt*, at Aschaffenburg, and I am more or less acquainted generally with the courses of study followed at most of the other Schools of Forestry in Europe; and I consider that some such course of study as the following would be equivalent for the purposes of our countrymen to that followed in any one of these valuable institutions, with the advantage of not requiring the acquisition of a foreign language, which few of our foresters and sons of foresters have facilities for effecting, or at least of effecting to such an extent as to enable them to understand instructions as thoroughly as they would instructions given in their own tongue:—

‘*FIRST YEAR.*

‘WINTER SESSION—

‘Instruction to be given in the structure and physiology of Trees and Shrubs; in the geographical distribution of Forests; in the treatment of Forests by *Sartage*, by *Jardinage*, by *à tire et aire*, and by *les Compartements*, or the *Fachwerke Methode* of Germany; in the application of this to coppice wood, with a view to securing,

along with other advantages, a sustained production of wood; and in the application of it to timber forests, according as the object may be to secure from these a maximum size of timber, or a maximum produce of wood, or a maximum pecuniary return, along with natural reproduction, sustained production, and progressive improvement of the woods; and in measures to be employed in the conversion of coppice wood into timber forests, of timber forests into coppice wood, of mixed woods into either, and of either into mixed woods;

‘With attendance on the classes in the University for the study of Natural History, of Mathematics, of Engineering; or with attendance on the classes in the Watt Institution and School of Arts for the study of Mechanical Philosophy, and of Mathematics.

‘SUMMER SESSION—

‘Attendance on the classes in the University for the study of Botany and Vegetable Histology; and of Practical Natural History; and of Practical Engineering; or attendance on classes, if open, in the Watt Institution for the study of Botany, and of Mechanical and Geometrical Drawing.

‘AUTUMN MONTHS—

‘Tours of observation, with or without the teacher, in woods and forests in Britain, in France, in Germany, or in the North of Europe.

‘*SECOND YEAR.*

‘WINTER MONTHS—

‘Instruction in regard to Forest Economy, Forest Legislation, and Forest Literature in Britain; in France and in Germany, countries in advance of all others in Forest Science, and in the practical application of it to the management of forests; in Russia, where arrangements are being made to introduce and to carry out extensively the improved forest manage-

ment practised in Germany and in France; in Finland, where arrangements have been made to manage the forests in accordance with the requirements of Forest Science; in Sweden, where the latest arrangements suggested by Forest Science are being carried out with vigour; in British Colonies; in the United States, and in India where have been introduced many of the suggestions of modern Forest Science, and the Forest Economy practised on the Continent of Europe;

‘With attendance at the classes in the University for the study of Theoretical Chemistry and Practical Chemistry, and Natural Philosophy, and the practical application of the same; or with attendance at the classes in the Watt Institution and School of Arts for the study of Chemistry, of Engineering, and of Geology.

‘SUMMER AND AUTUMN MONTHS—

‘Practical experience in the management of Woods, or in the management of Nurseries, to be acquired under the direction of approved foresters or approved nurserymen.

### ‘*THIRD YEAR.*

‘WINTER SESSION ONLY—

‘Instruction in the Chemistry of Vegetation and of Soils; in the Meteorological Effects of Forests on Moisture, on Temperature, and on Constituents of the Atmosphere; in Sylviculture, as applied in Belgium, &c., to utilise waste lands,—in the Landes of France, to arrest and utilise drift sands,—in the Alps, the Cévennes, and the Pyrenees, to prevent the disastrous effects and consequences of torrents,—on the Karst, in Illyria, to restore fertility to a land rendered sterile by the destruction of trees,—in the United States of America, to prevent anticipated evils,—in India, to secure desiderated good,—in

Britain, to increase amenity, covert, and shelter; and instruction in the injurious effects of animals, birds, insects, and various diseases on trees;

‘With attendance on the classes in the University for the study of Geology, of Agriculture, and, if it be desired, any of the following: for the study of Political Economy, of Conveyancing, or of Bandaging and Surgical Appliances; or with attendance on the classes in the Watt Institution for the study of Animal Physiology, of German, or of French.

‘In the curriculum which I have sketched, I have had regard to all that is required in Continental Forest Schools, and only to what is required in some, if not in all, of these institutions, in the study of what is included under the designation of Forest Science. I have also had regard only to the teaching power of the University of Edinburgh, and of the Watt Institution and School of Arts, as existing provision for the teaching of the classes specified.

‘In many of the institutions referred to, the provision for practical training in woods and forests is much more ample than is at present at command in Britain; but there is here a corresponding reduction in the time allotted to the curriculum; and this is so arranged that it may be entered upon at the commencement of any one of the sessions.

‘It is contemplated that the studies should be conducted by the use of text-books, by lectures, by oral examinations at which the students should be encouraged to ask questions of the teacher, by written exercises of various kinds, and by formal discussions by the students under the presidency of the teacher.

‘And it is contemplated that the class should meet for an hour five days a week, at a time which would not interfere with the classes attended at the University, or in the Watt Institution.’

In the enumeration of classes in the University and

in the Watt Institution which might be attended by students of Forestry, I gave the names of the professors, lecturers, and teachers then in charge of those classes. Many of the honoured men whose names were then cited, are no longer amongst us, but others have entered upon their labours, men to be associated with whom many would esteem to be an honour and a privilege.

For thoroughly efficient and satisfactory teaching in the subjects of special study mentioned, there would be required a staff of at least three teachers, one giving instruction in forest science ; a second, in forest economy and sylviculture ; and the third, in arboriculture and the management of woods and plantations such as are seen in Britain. But neither is it necessary to have so many teachers from the first ; nor is it necessary to have only these, or no others until these may have been installed.

A commencement might be made with one teacher, and I had almost said, with a teacher in any one of these departments of study. Supposing a commencement made with a teacher of forest science ; a teacher qualified for conducting the studies of a class satisfactorily in forest science would be one qualified for communicating instruction in both of the other departments ; and with such instruction in these as might be given by him, the promoters and supporters of the school might rest satisfied till the necessity for an addition being made to the teaching power of the institution began to manifest itself. Then, another being added, the first would be relieved of having to give instruction in the department assigned to the new teacher, whether this should be one or other of those mentioned, or some one or more of departments of study comprised under the comprehensive designation Forest Science ; and thereafter successive differentiations could be introduced as circumstances might require or warrant.

It may be questionable whether this could be done with a Professorship of Forestry in the University ;

but so far as appears, it might be done if arrangements were made for the study of forestry in connection with the Watt Institute, the Highland and Agricultural Society of Scotland, or in connection with the Museum of Science and Art in Edinburgh, on terms similar to those of the Royal School of Mines and Practical Geology in London, and the Royal College of Science in Dublin, all of which admit of expansion and curtailment, and changes being made more easily than could be done with a professorship in the University,

### SECTION 3.—EXPENSE.

The expenditure which might be entailed, by arrangements such as had been under consideration, should not, even with the expenditure already incurred on the annual maintenance of the Museum, make the total expenditure of the Department in Edinburgh equal to the expenditure on the Normal School of Science, and Royal School of Mines, in London; or approximate by thousands of pounds the expenditure on the Royal College of Science, and the Museum of Science and Art, in Dublin. Nor would it involve an expenditure on a National School of Forestry out of keeping with what is spent on such institutions elsewhere.

There is some difficulty in stating what may be considered the total expense incurred in the maintenance of almost any of the Schools of Forestry on the Continent: from this circumstance among others—in the published accounts no mention is made of what might be considered the equivalent of rent for the premises in which the school is located, and of the grounds connected with these—whether a simple arboretum, or an extensive forest as the case may be. I know not an exception. The premises and grounds, sometimes a mansion, sometimes a palace, with corresponding appointments, is granted by the Government free of reckoning. The rent of such premises,

if charged, would add greatly to the actual expenditure. But so would it be here.

On examination I find in the Forest Budget of Spain for 1882, and I have no reason to suppose that that was in any way an exceptional year, the credit asked and granted for the School of Forestry was 33,750 pesetas or francs; but this did not include the salaries drawn by the director, professors, and assistant professors, as members of advanced grades in the Corps of Forest Engineers, amounting to a much greater sum, probably about 70,000 pesetas; in all, 103,750 pesetas, say £4,600.

In the French Forest Budget for 1880, and in that of the preceding year, 1879, there was asked and granted for instruction in forestry 208,785 francs, about £8,700, of which sum 98,800 francs were designed for the School of Forestry at Nancy; and it is this alone perhaps with which we need concern ourselves here.

There existed at that time an organisation for imparting what is called secondary instruction in forestry in other schools situated at Villers-Cotterets, Grenoble, and Toulouse, to which forest engineers under forty years of age were admitted without being subjected to an entrance examination. The course of instruction extended over seven months; this was attended by men in active service, and any who passed satisfactorily the final or exit examination were eligible for appointment as *Garde-general adjoint*. But it was found by a sub-committee of the Chambre, to which had been submitted questions relative to the instruction in forestry, that the system followed at these schools failed generally to produce men fitted for the duties which the holders of that office were, by the forest regulations, required to discharge; and the committee recommended that these schools should be given up as not accomplishing the object for which they were organised. The instruction given in these schools represented an annual expense of 22,300 francs.

The credit granted also included provision for the Ecole Forestiere at Des Barres-Loiret, founded by M. Vilmorin,



and so designated by him in contradistinction on the one hand to a nursery, a designation borrowed from domestic life; and in contradistinction on the other hand to a plantation or forest, it being a collection of trees raised from seed obtained from forests or from nurserymen or seedsmen of note, and reared with a view to the study of their habits, their identity, and their differences: an establishment such as an arboretum might be made. Subsequently to the death of the founder it became State property. Since then it has been greatly extended, and there are received into it, after passing satisfactorily an entrance examination, sons of forest overseers, for two years' study, to prepare them for employment as gardeners or as forest warders; instruction being given to them in French, drawing, mathematics, land surveying, sylviculture, and all details of forest service. For this instruction there was allotted 20,610 francs, to cover the salaries of a director, of a *garde-general* or warder, and of a brigadier, the wages of the students, and other expenses for materials. The grant for the whole of the Schools was, as has been stated, 208,785 francs—say £9,280.

I cannot conceive of any circumstances in which the expenditure on a National School of Forestry in Edinburgh, if regulated by reasonable economy, should approximate that incurred on the maintenance of the School of Forestry in Nancy, or the School of Forestry in the Escorial, unless it expanded far beyond the arrangements found sufficient in these institutions; nor is it necessary that the expenditure at first should exceed what might be required to make efficient the teaching of one instructor, or afterwards be increased unless the first lectureship or professorship should produce results such as would make it manifest that it would be pecuniarily advantageous to the empire to perpetuate and extend the arrangements made. And these amounts are much short of the expenditure insured on the existing Royal School of Mines in London, and the Royal College of Science in Dublin.

On the Normal School of Science and Royal School of Mines in London there were expended in the financial year terminating on 31st March, 1885, £14,313, 2s 5d; on the Royal College of Science, Dublin, £6804, 1s 4d; with £14,056, 15s 10d for the Dublin Museum of Science and Art. The expenditure on the Edinburgh Museum of Science and Art was £10,689, 2s 11d, and such an arrangement as I have submitted for consideration would at first, or even when fully developed, require no such expenditure as these. And the expenditure would be entailed largely by provision for the support of students prosecuting their studies.

The arrangements for the support of students is similar, if not identical, in London and in Dublin. I may then take for illustration the Royal School of Science in Dublin. This supplies as far as practicable a complete course of instruction in science applicable to the industrial arts, especially those which may be classed broadly under the heads of mining, engineering, and manufactures, and it is intended also to aid in the instruction of teachers for the local Schools of Science. Students may enter as associates or as non-associates. By 'associate students' is meant all those who enter for the three years' 'curriculum of the college' in any department. There are nine 'royal exhibitions' of the value of £50 per annum, entitling the holder to free admission to all the lectures and to the laboratories; these are tenable for three years. And there are four 'royal scholarships' of the value of £50 yearly each. And there are thirty-six 'national scholarships.' These are of the value of 30s a week during the session of about nine months for three years, and they are tenable at the option of the holders at either the Royal College of Science, Dublin, or the Royal School of Mines, London. They also entitle the holders to free admission to all the lectures and all the laboratories.

Of the Royal Exhibitions, there are three open for competition annually. Of the Royal Scholarships, two

are offered for competition each year to students, not being royal exhibitors, on the completion of their first academic year. Of the National Scholarships, twelve are open for competition annually to persons who have taken a first or second certificate in the advanced stage in any subject of science in the examinations of the Science and Art Department, and who show that they are *bona-fide* science teachers. Holders of these may attend all the day lectures gratuitously, provided that they be examined on in at least one subject, and that they pay a fee of £1 for each course in which they propose to be examined.

The fees charged to associate students for lectures and laboratories average £15 a year. Students wishing to make one payment for the whole three years' course of lectures are allowed to compound for £25 in addition to the laboratory fees. The fees payable by non-associate students are £2 for each separate course of lectures, with charges for laboratory instruction, graduated in each class according to the time attended. A non-associate student taking a complete course of instruction is admitted at the same fees as are charged to associate students; and in any case such receive certificates after examination, if they have attended two-thirds of an entire course of lectures. By these arrangements provision is made for enabling students of limited means to meet the expense of board and education without loss of self-respect. They are similar to those carried out in London; and if such were made in connection with a School of Forestry in Edinburgh they would bring the course of study prescribed, in whole or in part as the student might wish, within reach of a great number of intelligent young men, who could not meet the expense of University life and University fees, with the advantage superadded that the holder of the exhibition or scholarship would have the satisfaction of knowing, and of having it known by his fellow-students, that this he has secured by giving evidence of his qualification for engaging in the studies to which he aspires,—which may be more than they could

have done. And at the same time, a certificate of his having obtained such exhibition or scholarship, with certificate of his having passed satisfactorily both the entrance and the exit examinations of such a Government institution, might have assigned to it a definite value in any application the holder might make for a Government appointment at home or abroad.

If similar provision were made for students of forestry, should a School be organised in connection with the Science and Art Department of the Committee of Council on Education, this would only be in keeping with what has hitherto been done for aspirants for employment in the Forest Service of India.

In an editorial note in the number of the *Journal of Forestry* issued in March, 1879, it is stated:—

‘ We regret to find that no attempt has yet been made to reduce the enormous expense to which the country, and the parents or guardians of a pupil, are put to pay for his training in the Forest School at Nancy, an institution, too, be it observed, that does not at all meet the requirements necessary for the *proper* training of first-class forest officers for the management of the forests in British India or in the Colonies. Each pupil costs, for fees and maintenance, £220 per annum, of which heavy sum the parents are held liable to pay £180, which may be reduced to an average of £120 per annum by the industry and good conduct of the pupil; in reward for which the Government, at its discretion, pays the difference, £60 per annum.

‘ Such heavy charges can only be afforded by the opulent classes, and very much exceed the cost of training for any other profession in this country. They are also quite prohibitory to the young men best qualified by nature and early training for filling the office of forest officers in India or elsewhere. For less than half that cost per head per annum we train our clergy, doctors, lawyers, naval and military officers, engineers, &c.; in fact, we do not know of any professional training which necessarily requires such

an enormous expenditure for such poor results. Suppose there is an annual average of fifteen pupils being trained at Nancy for the Indian forest service. This would give a total cost of £3000 per annum. Such a large sum properly expended in training forest students in a Forest Department in connection with any of our Universities would train fifty students in place of fifteen, and make much superior men of them for the duties they are called on to perform in the management of our home, colonial, and Indian forests. The *special* training for India, or any colony, should be taught in that country. The science and technics of forestry can be better and more economically taught in Britain than anywhere else, and the practical training specially necessary for any particular country cannot be so well taught anywhere as on the spot where it has to be put into practice.'

Mr W. G. Pedder, revenue secretary, India Office, in giving evidence before a Select Committee of the House of Commons in July 1885, it is reported in a subsequent issue of that periodical, September 1885, stated, in regard to candidates for employment in the Forest Department in India:—'It was found that the young men sent to France were not sufficiently well acquainted with the French language to acquire knowledge through that medium. A change has consequently been made. The young officers selected were sent to undergo a course at the Royal Engineering College at West Hill, where they were instructed in the ordinary engineering education, and in addition were taught Forestry, and Botany, and Forest Law, and Jurisprudence. . . . No application had been received from other than the Indian Department; but no doubt other students would be received, who would pay the fees of £180 a year, including everything excepting pocket-money.'

At much less expense than this, then, might be provided in Edinburgh, education, instruction, and training, equal to what has hitherto been given to candidates for appoint-

ments as forest officials in India; and such, it may be assumed, would suffice for candidates for similar appointments in our colonies and at home.

In an editorial note in the *Journal of Forestry* for March, 1886, it is stated:—

‘The fees for the course of training at the Forestry School at Cooper’s Hill are, according to the evidence given by Mr Pedder before the Select Committee on Forestry, fixed at £180 a year for each student. This sum covers all expenses except pocket money, viz., board and lodgings, lectures, and a six weeks’ tour annually to the Forest School at Nancy. The sum is large, so large indeed as to be prohibitory to all poor aspirants for distinction in forestry science; we do not, however, say nor imply that the amount is too large to cover the expenses of the scheme on which the school is founded. This is a point we do not at present intend to touch upon. What strikes us as most objectionable in connection with these high fees is the fact that they will narrow the field whence forestry students may be drawn, in such a way as to exclude the whole of those who may be reasonably expected to be specially fitted by the circumstances and associations of their early years to enter on the study with a bent in its favour that would assure the highest success. We allude to the sons of practical foresters, and to young foresters generally. It may fairly be presumed that young men who have been associated with trees and with woodland management for many of the earlier years of their life, have acquired a large amount of information of a practical kind respecting these subjects, and also a love of trees, which not one in a thousand candidates from any other field can possibly possess. Yet this valuable element is to be excluded from the public service because they are unable to pay the fees which are required to cover the expenses of the scheme of training decided upon. Surely this is matter for deep regret from all points of view. The annual fee is in point of fact three or four times the amount of the yearly salary of the average English forester. It is therefore obvious

that he cannot place his son at Cooper's Hill Forestry School, let his capacity and bent for such a career be ever so conspicuously marked. This we consider is a serious mistake, alike in national and individual interests, at which should be speedily rectified by some means, either at Cooper's Hill, or by the establishment of a less costly school elsewhere. The six weeks' annual sojourn of the students in France must add very materially to the costs of the establishment at Cooper's Hill, and, it may be asked, for what good? It is difficult for any one outside the pale of officialism to conceive what practical advantage will accrue to the Indian Forest Service (in whose interests this annual continental visit of students is planned) from a mere holiday of a few youths to the forests in connection with the school at Nancy, during which in the circumstances they can see and learn little that they may not see and learn in India, where a similar system of forest management is in practice. Obviously it must be a matter of very little consequence whether these youths reach India with or without twelve weeks of such experience, if they have undergone the course of scientific and technical training prescribed in all other respects satisfactorily. It would be incredible to suppose that such a meagre insight into the practical features of silviculture as may be obtained in the circumstances would be considered sufficient qualification in the estimation of the authorities to place these young men in posts of responsibility—as, for instance, to direct or control labour in the forest without superior control—immediately on their arrival in India. Although we are told by the same witness, in the same report that only the inferior grades of forest officers are trained in India, it is too absurd to imagine that there is no course of training for the young men who have passed at Cooper's Hill as qualified at from 19 to 24 years of age after their arrival in India. If then, as we are bound to assume is the case, these students arrive in India incapable of undertaking even subordinate responsibility in practical forest work, after they have finished their course of study

at Cooper's Hill, would the omission of their annual visit to Nancy of six weeks for two successive years be a regrettable matter in any way? We think not, but leave practical people to draw their own conclusions.'



### CHAPTER III.

#### RELATIVE IMPORTANCE TO A SCHOOL OF FORESTRY, OF SCHOLASTIC SURROUNDINGS, AND OF ADJACENT FORESTS.

IN discussing in a preceding chapter the question of an appropriate site for a British National School of Forestry, I have adverted [ante p. 174] to the practicability of securing by feu, property in the immediate vicinity of Edinburgh, on which might be created a forest, in the creation and subsequent management of which students might hereafter be exercised in all that pertains to practical forestry, if Edinburgh should be selected as the site of such a School of Forestry.

This matter demands further consideration in connection with the subject of the immediately preceding chapter—that of expense. Is such a forest really necessary to the efficient teaching of forestry and forest science? Many will say yes; beyond all doubt or question it is. That advantage might be derived from the creation of such a forest may be freely admitted; and that thus the efficiency of the teaching might be increased need not be denied, but the expense would be considerable, and I do not consider it necessary that that expense should be incurred. It may be asked, Is it not necessary to the efficiency of a School of Forestry to have adjacent to it a forest, in which the students may be exercised in various departments of forest work? There prevails in Britain an opinion that it is. But I consider this a prejudice, by which I mean an opinion formed *a priori*, and not the result of observation; and one which has retarded the establishment of a School of Forestry in Britain, by suggestions of an enormous expenditure for which it would be difficult to provide.

Dr James Brown, in his treatise on Forestry,\* already referred to, laments that there is not a school in Great Britain where young men can learn efficiently all the branches of study in connection with forestry; and he gives the following advice as to the way in which a self-supporting institution for that purpose might be established: 'Let an arboricultural association be formed of some of the leading landed proprietors in the country, with a few men of science among them, having for their object the cultivation of trees on the most approved and improved principles of the age, and the training up of young men as foresters according to these principles, in order to fill the places of the existing foresters of the school, and thus as early as possible bring about an improved state of arboriculture for the general welfare of the country.

'Then, supposing that such an association were formed, where and how is the field of their operations to be had? Of course, they could not undertake anything in a definite and practical way in respect to forestry without this. Such a field may be easily had, as there are many landed proprietors in this country who have more estates than one, and who would be willing, I have no doubt, to give over the woodlands on one of them for the purpose of forming an arboricultural school of it, of course under safe and proper conditions to both parties. The outline of the conditions might be made somewhat as follows: The proprietor, R. F., lets to the association——, for a period of, say forty years from date, all the woodlands at present on the estate of A., extending to about 2000 acres, as per plan of the property to be referred to, at an annual rent of £——. The several crops embraced to be thinned, and otherwise to be dealt with for their improvement in health and value by the said association, and according to a mode to be proposed by them and approved of by the said R. F., the proprietor, who is to sell the timber and

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\* 'Forestry; or, A practical treatise on the planting, rearing, and general management of forest trees.' Fourth edition. William Blackwood & Sons, Edinburgh and London. 1871.

other produce for his own behoof, the association to be paid by him for the labour performed by them in dealing with the works of thinning and otherwise improving the crops, as may be agreed upon, all at the usual rates for such works; these to be agreed on between the association and the said proprietor's agent at the beginning of each year, and before the works commence for the season. And the said R. F., the proprietor, lets also to the said association, for the said period of forty years, for the purpose of being planted by them from time to time with suitable kinds of trees, as may be agreed on between the parties, that piece of waste land known as——, and extending to 1800 acres, at the annual rent of £——. This portion of land is let to the association on the understanding that, at the end of their lease, the said R. F., the proprietor, shall take over all the crops that shall then be found growing on it, at a valuation to be settled by two neutral men of skill, mutually chosen, when the said R. F., or his heirs, will pay the association the full value that may then be made in respect to the crops of trees that may have been planted by them on said land. And it is to be understood that during the currency of the lease the said association shall have full power to manage the woods they may plant on said waste land in their own way and as they may think fit, and to use for their own behoof all proceeds arising from them; it being understood, however, that all the crops they may plant shall be properly treated and trained, so as to insure their being valuable to the estate as a crop on the land, when they are handed over to the proprietor of the land at the end of the lease. And it is also agreed that the said association shall have no power to clear any portion of said crops or trees they may plant, or any portion of any crops, whatever, without the consent of the proprietor of the land. . . . .

'A president and vice-presidents, with directors, would have to be appointed, as also a secretary, a treasurer, and auditor. Next, the working-resident staff might be a manager, who would be accountable to the president and

directors for the proper working of the objects of the association. He would be assisted by a professor of botany and vegetable physiology, and one of geology and chemistry, the latter combining physical geography and climatic science; while he, the manager, would also have the assistance of a first-class practical forester, whose duties would be to carry out all the practical operations, under the directions of the manager, in dealing with the woods, and at the same time instruct and guide the pupils while at their various works in the woods.

‘ To accommodate a staff of this kind, together with, say fifty or sixty pupils, a convenient house would require to be provided, and as to whether the pupils would be resident in it or not, would of course depend on a careful consideration of all the circumstances in connection with the locality in which the field was situated. At all events, one-half of the pupils would require to attend at a given hour every morning, to hear lectures and other instructions on the subjects to be taught by the professors, while the other half would go out to work in the woods. These would return in the afternoon to get their course of instructions, while those who were studying in the morning would go out and take their places in the woods; and in this way the routine of daily theoretical and practical instructions would be carried on. Of course a portion of the waste land would be taken up for planting every year, in order to have the young men trained to the proper way of doing it, as also thinning in the different plantations, with bark-stripping, pruning where necessary, draining, &c. In short, all these branches of work would be undertaken every year on some portion of the crops; and as all the works would be performed by the pupils themselves, under the direction of the forester, every one would have the full opportunity of gaining practical experience, as well as theoretical knowledge, on the various branches of forestry. And it would be necessary to keep all the woods under the management of the association in the very best possible condition, so that

their character might become a model for all others to imitate. And, besides, it would be desirable for the manager and his professors to visit, from time to time, the woods on other properties, and take with them their pupils to see them, when they would have an opportunity of comparing the management of other woods with that of those on their home district; and in this way the pupils would get much useful information and experience, within the shortest possible time, under the guidance of their teachers, and thus render them more intelligent and experienced than they would be were their observations confined to the woods on the home field alone. . . .

‘In dealing with the pupils, the amount of fees they would pay would, of course, depend upon whether they were lodged in the institution or not, and had bed and board provided for them. I should say that they should be resident in the institution, and all receive like treatment as to education, board, and lodging. If they were not resident lodgers, irregularity would be certain to ensue, and want of proper rule. Then, if lodged, £50 a year might be a fair charge for each pupil. At all events, it should not exceed this sum. In accounting with the pupils they ought to have put to their credit, and deducted from their fees at the end of each term, when settlement is made, the value of the work they perform in the woods, at a fixed rate per hour or per day, as may be arranged. This would make them more industrious than they otherwise would be, and make them take good interest in the works they were engaged in. This value of work would, of course, be refunded to the association by their account against the proprietor of the woods for the work performed in them by their pupils.

‘In order that the pupils might be properly instructed in all the branches bearing on arboriculture, and to secure the professors and all concerned doing their duties, an examination of the progress made by the pupils should be made by the president and directors at the end of every six months, and afterwards put to the credit of the most proficient and deserving. . . .

‘As the young men became proficient in all the branches (after three years’ residence at the institution), theoretical and practical, of forestry, and leave the institution, they should have each his certificate or diploma, stating his general acquirements and abilities, and whether he is *first, second, or third* class in his profession. These certificates should of course be given by the president and directors, and signed also by the professors; and they should form a guarantee to landed proprietors who might be in want of foresters that the holders are men of undoubted professional abilities, and worthy of being trusted with the management of their woods.’

In the first editorial article in the *Journal of Forestry* it is said, vol. i., p. 9: ‘It is necessary for a properly equipped Forest School to have a large extent of forest attached to it, having a variety of elevations and soils suitable for the profitable cultivation of all our hardy trees, besides the garden, nursery, or arboretum, which forms the nucleus or head-quarters for the schools. By proper arrangements, such an extent of suitable land could be got within easy reach of Edinburgh, along the slopes amongst the glens, and upon the Pentland Hills; or if for a school in England, amid the uplands of Surrey and Hants, or among the hills of Derbyshire, or in Wales, where trees thrive to perfection, and the land is of comparatively small value for any other purpose.’

At a meeting of the English Arboricultural Society held last summer—1886, there was advocated by Mr Wallace, land agent for Ravensworth, the purchase, with Government assistance, of a large tract in the Northumbrian Hills for a Forest School on a large scale. It was with the design that this should be in addition to anything which might be done in Scotland, it being alleged that it was well known that trees growing luxuriantly in Scotland will not live in the north of England.

In the evidence given before the Select Committee of the House of Commons by others, the same idea was advanced. I have intimated that I think otherwise.

The earlier German Schools of Forestry were instituted in connection with forestal operations, and consequently in connection with extensive forests; and the earlier Schools of Forestry instituted in accordance with them as a model were naturally established in connection with some extensive forest. But after a more extended experience had been gained, and greater facilities for travelling great distances at comparatively little expense were created, the Schools of Forestry were removed from the forests to seats of learning in the cities and towns, and combined with Universities and Polytechnicums, and Schools of Agriculture and Rural Economy, and only in connection with like educational institutions do I know of Schools of Forestry having been of late years organised.

It appeared to me in visiting Schools of Forestry and in reading of their origin and existence, that most, if not all, of the old-established institutions were adjacent to forests, while most, if not all, of the later founded schools were not; and that some of these made much more use of forests somewhat remote from them for the practical training of students than did some of the former appear to me to make of like facilities for the work at their own door.

I have met with convictions in favour of different forms of ecclesiastically prevailing on this side, and on that of geographical boundaries; and so have I seen it with these conflicting opinions in regard to such forests. In the older Schools of Forestry in Germany, which are in the northern part of the Empire, we have the former; in the later formed schools in the south we have the later.

And certainly it was the case that practical training was not neglected by any—I never heard a complaint made of want of facility for securing this; and my opinion is decidedly in favour of the education and technical instruction being

prosecuted in connection with facilities for prosecuting without interruption these and higher studies, with some time spent annually in observing, and, if possible, in practising forestal operations under properly qualified teachers of practical forestry. And I have stated in the preceding chapter, on an appropriate site for a British National School of Forestry [ante. pp. 174-7], how this might be done if Edinburgh were made choice of for the site of such a school.

Having made this statement, I feel free to advance, and state that I have never known of a forest official in the south of Germany advocate a return to the old model in so far as this was essentially a school organised in connection with a forest, and I have never known such a location for a School of Forestry advocated in Germany or out of Germany by any one known to me to be acquainted with the details of instruction in different existing Schools of Forestry, who had not himself been educated at a School of Forestry so located. I do not call in question the fact that such may have had far better opportunities of forming a satisfactory opinion on the subject from experience than I have from limited personal observation and hearsay; and I have mentioned the fact cited in the full knowledge that it may tell both ways.

In more than one case on visiting a School of Forestry, I have looked in vain for a forest, or even for an Arboretum, such as that in Edinburgh is becoming, and yet may become; and even where a removal of location has been made to the site now occupied by a school adjacent to a forest, it has never been from a University town to an exclusively forest district, but the reverse, with perhaps an exception which will be mentioned.

In Denmark, the School of Forestry is connected with the School of Agriculture and Rural Economy in Copenhagen. In Sweden, the principal School of Forestry is in Stockholm, and the practical training is effected at a distance. In Finland, the School of Forestry is at Evois,



adjacent to a forest; but the practical training is conducted elsewhere. In Russia, the principal Schools of Forestry are in St. Petersburg and Moscow; the practical training is at Lissino. In Saxony, the School of Forestry is at Tharand, adjacent to a forest. In Prussia, the School of Forestry is at Neustadt Eberwalde, adjacent to a forest. In Hanover, it is at Munden. In Hesse-Darmstadt, the School of Forestry, after mature deliberation, was incorporated with the University of Giessen. In Baden, the School of Forestry is connected with the Polytechnicum of Carlsruhe. In Wurtemberg, it was part of the Royal Academy of Rural and Forest Economy at Hohenheim; but I understand it is now combined with the University of Tübingen. In Bavaria, the School of Forestry acquired a high reputation at Aschaffenburg, whence it was removed to be combined with the University of Munich; subsequently Aschaffenburg was re-occupied as a preparatory School of Forestry, from which students proceed to Munich: but my latest information from Bavaria does not speak in commendation of the measure. Be this as it may, it is the only case of the kind known to me. The buildings were vacant; the inhabitants of the adjacent town were urgent; but even if the most were made of it, it could scarcely be considered an exception to what I have stated. In Austria, the School of Forestry has been removed from Mariabrunn to Vienna. In Italy, the School of Forestry is at Vallambrosa, in the midst of a forest; and in Gotha, the School of Forestry is in Eisenach, not far from a forest. In Switzerland, the School of Forestry is combined with the Polytechnicum at Zurich. In France, the School of Forestry is in Nancy, adjacent to a forest. In Spain, the School of Forestry has been removed from Villaviciosa to the Escorial, where an effort was made to establish an Arboretum, but this was interrupted; and the maintenance of a crown forest in a distant province, as a special school for practical instruction, has been abandoned. I have met with no indication of opinion in Spain, that the school in the Escorial has at

any period of its history suffered from not being adjacent to such a forest as is spoken of; and looking at the experience of schools of industry on the Continent, I am satisfied that there is no necessity for the organisation of a School of Forestry in Britain being clogged with the supposition that it must be located in a forest.

The relative advantages of having forestry, including under that designation both forest science and forest economy, taught in isolated professional Schools of Forestry, and of having it taught by professors of forestry in Universities and other educational institutions of a like comprehensive character, has been exhaustively discussed in Germany, the birthplace of forestry and of modern Schools of Forestry; and an unequivocal expression of opinion in favour of the latter arrangement was given at a Congress of German Foresters, held in the autumn of 1874 at Freiburg, in the Breisgau, in the Grand Duchy of Baden.

It was the third Congress of these which had been held in Germany, and it was numerously attended, more numerously than either of the preceding meetings. The members of the Congress were from all parts of Germany, and from countries adjacent: 134 were from Baden; 55 from Bavaria; 55 from Prussia; 41 from Wurtemberg; 35 from Alsace-Lorraine; 21 from the Central German States; 15 from Hesse; and there were besides 18 from Switzerland, 3 from Austria, and 1 from Russia—378 in all. In that number were 23 members who were not professional foresters; a large proportion of the authors of German works on forestry were there, and many Government officials entrusted with the administration of forest management in Prussia, Bavaria, Wurtemberg, Hesse, and Baden.

The president chosen was Dr Nördlinger, *Forstrath*, and then Professor of Forestry at Hohenheim.

Four subjects had been proposed for discussion, and the first of these was that above referred to, which was stated

thus, '*Forstakademie oder Allgemeine Hochschule?*' *Forst Academie* being the name given to isolated educational institutions designed exclusively for the study of forest science and forestry; *Allgemeine Hochschule*, the comprehensive designation given to colleges in which provision is made for a much more extensive and comprehensive course of study being followed, if desired, while attendance may be confined to specified classes if this be required or preferred.

Such *Allgemeine Hochschulen* are the following:—The Royal Academy of Land and Forest Economy at Hohenheim in Bavaria, in which there are three distinct departments of study:—1. *Landwirthschaft*, or Rural Economy, inclusive of agriculture, horticulture, cattle breeding, &c. 2. *Forstwirthschaft*, or Forest Economy in all its departments; and 3. *Grund-und-Hilfs-Wissenschaften*, or sciences on which these are based, and sciences by which they may be advanced, including mathematics, physical science, technical arts, political economy, and jurisprudence. For the teaching of all of these there is provided a staff of professors, &c., with all necessary appliances. And the Polytechnic School at Carlsruhe, in the Grand Duchy of Baden, in which there is embodied—1. A school of mathematics. 2. A school of engineering. 3. A school of machinery. 4. A school of architecture. 5. A school of forestry. For the teaching of all these there is provided a staff of forty-nine professors, lecturers, college tutors, and assistants, with all necessary appliances. And the designation is susceptible of such distention as to include universities.

The interest created by this discussion was great and wide-spread. Both official\* and private reports of it were published.

For the following information I am indebted to an account of the Congress furnished by Herr J. Lehr to the *Allgemeine Forst-und Jagd Zeitung*, edited by Professor Dr Gustav

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\* Bericht über die III. Versammlung deutscher Forstmänner zu Freiburg i. B. Vom 1bis. 5. September, 1874, pp. 212 Svo. Berlin, 1875. Verlag von Julius Springer.

Heyer, Director of the Forest Academy of Münden, in Hanover, and Privy Councillor of the kingdom of Prussia.

The question gave occasion for a discussion occupying six hours, which was conducted with ability, and listened to throughout with marked attention, the sederunt, commencing at 8 A.M., being continued with an hour's interval till three o'clock in the afternoon. It appears to have been a continuation or resumption of a discussion of the same subject at Mühlhausen the year before. Two distinguished students of forest science had been appointed to open the discussion by reading papers, each stating the case in favour of that one of the arrangements which he approved.

The discussion was opened by Oberforstmeister Professor Dankelmann, Professor of the School of Forestry at Neustadt-Eberswalde, in Prussia, defending the organisation of forest academies in preference to the substitution for these of arrangements for the study of forest science in Universities or other seats of learning.

The second speaker appointed to open the discussion was Dr Von Seckendorff, from Austria, Professor and Councillor of State, who spoke in support of the proposal to combine Schools of Forestry with *Hochschulen* in which other studies were prosecuted, and stated—in reference to an allegation which had been made, that the movement had originated entirely with professors and candidates for professors' chairs, and not with practical foresters, or forest administrators—that the opinion held by him he had found shared by numerous forest officials with whom he had been brought into contact in other lands, and more especially by those of them who had studied at forest academies, a very great majority of whom had spoken of a combination of Schools of Forestry with the *Hochschulen* as a thing demanded by the honourable standing of forest science and of the forest service.

Before the introducers of the discussion had commenced the delivery of their addresses, several gentlemen, all from Prussia, had announced their intention to speak in

defence of the maintenance of the special professional schools. It was now proposed, and agreed to, that as in the meantime a great many friends of the *Allgemeine Hochschule* had added their names to the list of intending speakers, speakers *pro et contra* should alternately address the meeting.

There spoke in succession Dr R. Hartig, Professor in Neustadt-Eberswalde, in Prussia ; Oberförster Heiss, from Neustadt, in the Palatinate ; Oberförster Ilse, from Beurig-Saarburg, near Treves ; Forstmeister Ganghofer, from Würtzburg, in Bavaria ; Forstmeister Bando, from Neustadt-Eberswalde, in Prussia ; Dr Borggreve, Professor in Bonn (Poppelsdorf), on the Rhine. Dr Lothar Meyer, Professor in Karlsruhe, in the Grand Duchy of Baden ; Dr Gerstner, Professor in Würtzburg, in Bavaria ; and Professor Dankelmann replied.

Thereafter the President desired those who wished to give their vote in favour of professional school instruction in forestry being combined with that given in the *Allgemeine Hochschulen* to stand up, when the whole assembly seemed to rise with loud cheering. Then those who were in favour of the continued maintenance of separate Schools of Forestry were requested to stand up, when sixteen members only of the assembly stood up. Thus was the decision of the Congress given in favour of the former arrangement.

## CHAPTER IV.

### FORESTAL LITERATURE.

UNIQUE as may be our position among the nations of Europe, in not having either in Britain or in any of our Colonies, a School of Forestry, or provision for the study of Forest Science, beyond arrangements made for candidates for employment in the Forest Service of India, which have been latterly introduced into the College of Engineering at Cooper's Hill, our position is scarcely less unique in regard to forest literature.

In my Plea for the creation of a School of Forestry in connection with the Arboretum, published in 1877, in illustration of the difference in the amount of literature existing in our language and in the language of Continental Europe, and as indicative of the magnitude of the change which is passing over different lands in which the English language is the language of the people, I asked to be allowed to make the following statement, though in its commencement personal to myself:—

‘I went to the Cape of Good Hope to act as Colonial Botanist in the beginning of 1863. On my arrival I was officially informed that the office had been created some five years before with the two-fold object (1) of ascertaining and making generally known the economic resources of the Colony, as regards its indigenous vegetable productions, and its fitness for the growth of valuable exotic trees and other plants; and (2) of perfecting our knowledge of the flora of South Africa, and thus contributing to the advancement of botanical science.

‘On making my first tour of the Colony to see its flora and its capabilities, I found myself face to face with a

difficulty in the way of the developement of these capabilities, arising from a reckless destruction of forests and of forest products which was going on, and a progressive desiccation of the climate, accompanying or following the destruction of forests and the burning of herbage and bush in connection with agricultural operations and pastoral husbandry. And I knew not then, nor do I know now, of a single work published in England from which I could then have procured information in regard to the treatment required by aboriginal forests, to secure their conservation and improvement, excepting *Forests and Gardens of South India*, by Dr Cleghorn, then Conservator of Forests in the Madras Presidency; *The Forester*, by Dr James Brown; the *Arboretum et Fruticetum Britannicum*, by Loudon; and *English Forests and Forest Trees*, an anonymous work published by Ingram, Cooke, & Co., London. But none of these supplied the information I required.

‘Contrast with this the richness of continental languages in literature on such subjects. I have had sent to me lately *Ofversigt af Svenska Skogslitteraturen, Bibliografiska Studieren af Axel Cnattingius*, a long list of books and papers in Forest Science published in Sweden; I have also had sent to me a work by Don José Jordana y Morera, Ingeniero de Montes, under the title of *Apuntes Bibliographic Forestale*, a catalogue raisonné of 1126 printed books, MSS. &c., in Spanish, on subjects connected with Forest Science.

‘I am at present preparing for the press a report on measures adopted in France, Germany, Hungary, and elsewhere, to arrest and utilise drift-sand by planting them with grasses and trees; and in *Der Europaeische Flug sand und seine Kultur, von Josef Wessely General-Domaenen-Inspektor, und Forst-Academie-Direktor*, published in Vienna in 1873, I find a list of upwards of 100 books and papers on that one department of the subject, of which 30, in Hungarian, Latin, and German, were published in Hungary alone.

‘According to the statement of one gentleman, to whom application was made by a representation of the Government at the Cape for information in regard to what suit-

able works on Forest Economy could be procured from Germany, the works on *Forst-Wissenschaft*, Forest Science, and *Forst-Wirtschaft*, Forest Economy, in the German language, may be reckoned by cartloads. From what I know of the abundance of works in German, on subjects connected with forestry, I am not surprised that such a report should have been given. And with the works in German may be reckoned the works in French

‘In Hermann Schmidt’s *Fach Katalogue*, published in Prague last year (1876), there are given the titles, &c., of German works in *Forst-und Jagd-Literatur*, published from 1870 to 1875 inclusive, to the 31st of October of the latter year, amounting in all to 650, exclusive of others given in an appendix, containing a selection of the works published prior to 1870. They are classified thus:—General Forest Economy, 93; Forest Botany, 60; Forest History and Statistics, 50; Forest Legislation and Game Laws, 56; Forest Mathematics, 25; Forest Tables and Measurements. &c., 148; Forest Technology, 6; Forest Zoology, 19; Peat and Bog Treatment, 14; Forest Calendars, 6; Forest and Game Periodicals, 27; Forest Union and Year Books, 13; Game, 91; Forestry and Game in Bohemian, 44—in all, 652. Upwards of a hundred new books published annually. Amongst the works mentioned is a volume entitled *Die Literatur des letzten sieben Jahre (1862-1872) aus dem Gesamtgebiete der Land und Forst-wirtschaft mit Einschluss der landw. Gewerbe u. der Jagd, in Deutscher, Französischer u. Englischer Sprache Herausg. v. d. Buchhandl. v. Gerold & Co., in Wien, 1873*, a valuable catalogue of 278 pages in large octavo.

‘Since the time of which I have spoken, fifteen years ago, a change has manifested itself in the different lands in which the English language is spoken. By an order of the House of Commons, dated 17th August, 1871, there was printed the “Return to an address of the House, dated 15th May of the same year: a selection of dispatches and their enclosures to and from the Secretary



of State for India in Council, on Forest Conservancy in India, showing the measures which have been adopted, and the measures which are going on, in the several presidencies and lieutenant-governorships, beginning with the dispatch from the Governor-General in Council, of 21st day of May, 1862, to the present time." And the Return comprises two printed volumes, consisting of 1671 folio pages on India, one of 441 pages on Madras, and one of 357 pages on Bombay—in all, 2469 pages folio. And they report an approved estimate of expenditure, for the year 1871-1872, on forests in the Indian Empire of 45,11,000 rupees, and an estimated income of 57,34,000 rupees; or, according to another account, an annual expenditure of upwards of £450,000, with annual returns of upwards of £570,000.

'In 1871 a commission was appointed by the Government of Victoria to report amongst other things on the best means of promoting the culture, extension, and preservation of State Forests in Victoria, and the introduction of such foreign trees as may be suitable to the climate, and useful for industrious purposes, which Committee has gone to considerable expense and trouble in collecting and printing information from New Zealand, India, the United States, Hanover, Prussia, Saxony, Bavaria, Austria, Baden, Italy, and Sweden, as well as Great Britain, availing themselves largely of the published report by Captain Campbell Walker on State Forests and forest management in Germany and Austria, which I have cited in speaking of the Forest Schools of Germany.

'In the Report of the Commission of Agriculture, laid before the Senate and the House of Representatives of the United States, in 1865, there was embodied a Memoir on "American Forests—their Destruction and Preservation," by the Rev. Frederick Starr, of St. Louis, Missouri, of which Report 165,000 copies were ordered by the House of Representatives to be printed, and within a week 20,000 "extra copies" were ordered by the Senate.'

The work by Sennor Jordana cited in this quotation was published in 1875, and referred, as has been stated, to works which had appeared in Spain previous to 1860.

Apart from the forestal literature which was in existence in Spain previous to the establishment of a School of Forest Engineers, there has been issued in connection with demands felt in connection with operations resulting from that enterprise, numerous works on subjects connected with Forest Science and modern Forest Economy. There have been given in a preceding chapter [ante pp. 136-143] the titles of a hundred and fifty of these, with the dates of publication, and the names of the writers—forty-two in number—all of which works may be considered works designed to meet a felt want; and most of them have been published within the last ten years.

We cannot compare with such progress; but a beginning has been made in the publication of similar works in our language.

The "Plea" issued by me was published in the spring of 1877. Within a month thereafter there was issued the first number of the *Journal of Forestry*. The first paragraph of the Introductory Editorial Notes urged the establishment in the British Islands of a School of Forestry. From that day till the close of the publication of the periodical with the issue for April last, prominence has been given to this matter in the pages of that journal; and in it valuable contributions have been made to the forest literature of our country. Long before that there had been organised the Scottish Arboricultural Society; one of the first subjects brought before them was the expediency of securing some such institution, and with like pertinacity to that of the *Journal of Forestry*, the published transactions of the Society have urged this measure, and added to our stores of information in regard to forests and forest operations in Scotland. During the period within which these transactions have been pub-

lished repeated new and enlarged editions have appeared of *The Forester: a Practical Treatise on the Planting, Rearing, and General Management of Forest Trees*, by Dr James Brown, lately deceased, one of the fathers and founders of the Society.

This work of Dr James Brown constitutes a kind of connecting link between the past and the present. It is likely long to hold its place as an authority on the subjects of which it treats—different from, but related to, other matters brought forward in connection with the advanced forest science of the day, but gracefully, and of right, taking its place amongst these. And something similar may be said of many other works, published in Great Britain both before and since; prominent amongst which are some of the works of Loudon.

It may have been noticed that amongst the forestal works published in Spain, within the last fifteen years, are many prepared in accordance with the arrangement in connection with the School, whereby professors and others are commissioned to visit foreign lands, on special errands relating to some one or more departments of research or of practical operations pertaining to forestry; and to report the results, for consideration in connection with corresponding researches or forestal operations carried on in Spain, provision being made for their expenses being paid by the State, and for the report being published at the expense of the State, if this be recommended by the *Facultative Junta*, and approved by the Minister of State entrusted with the cognisance of the School.

Some years ago, in the Scottish Arboricultural Society, there was mooted by Mr Hutchieson of Carlowrie, one of the vice-presidents of the Society, the project of an International Forestry Exhibition; and when the project was carried into effect it was with a view to promote a movement for the establishment of a National School of Forestry in Scotland, as well as with a view of furthering and stimulating a greater improvement in the scientific

management of woods in Scotland and the sister countries which has manifested itself during recent years.

At the meeting at which the movement for the accomplishment of this was formally initiated, all of those who were present formally pledged themselves to give their best efforts and endeavours to render the Exhibition a success, and of such importance and general interest as to make it worthy of the name of International. In redemption of this pledge I published popular treatises on the following subjects:—

*I.—Introduction to the Study of Modern Forest Economy.*

In this there are brought under consideration the extensive destruction of forests which has taken place in Europe and elsewhere, with notices of disastrous consequences which have followed—diminished supply of timber and firewood, droughts, floods, landslips, and sand-drifts—and notices of the appliances of Modern Forest Science successfully to counteract these evils by conservation, planting, and improved exploitation, under scientific administration and management.

*II.—The Forests of England; and the Management of them in Bye-gone Times.*

Ancient forests, chases, parks, warrens, and woods, are described; details are given of destructive treatment to which they have been subjected, and of legislation and literature relating to them previous to the present century.

*III.—Forestry of Norway.*

There are described in successive chapters the general features of the country. Details are given of the geographical distribution of forest trees, followed by discussions of conditions by which this has been determined—heat, moisture, soil, and exposure. The effects of glacial action on the contour of the country are noticed, with accounts of existing glaciers and snow-fields. And information is supplied in regard to forest exploitation and the transport of timber, in regard to the export timber trade, to public instruction in silviculture, and to forest administration, and to ship-building and shipping.

*IV.—Finland: its Forests and Forest Management.*

In this volume is supplied information in regard to the

lakes and rivers of Finland, known as *The Land of a Thousand Lakes*, and as *The Last-born Daughter of the Sea*; in regard to its physical geography, including notices of the contour of the country, its geological formations and indications of glacial action, its flora, fauna, and climate; and in regard to its forest economy, embracing a discussion of the advantages and disadvantages of *Svedjande*, the *Sartage* of France, and the *Koomaree* of India; and the details of the development of Modern Forest Economy in Finland, with notices of its School of Forestry, of its forests and forest trees, of the disposal of its forest products, and of its legislation and literature in forestry are given.

V.—*Forest Lands and Forestry of Northern Russia.*

Details are given of a trip from St. Petersburg to the forests around Petrozavodsk on Lake Onega, in the government of Olonetz; a description of the forests on that government by Mr Judrae, a forest official of high position; and of the forests of Archangel by Mr Hepworth Dixon, of Lapland, of the land of the Samoides and of Nova Zembla; of the exploitation of the forests by *Jardinage*, and of the evils of such exploitation; and of the export timber trade, and disposal of forest products. In connection with discussions of the physical geography of the region information is supplied in regard to the contour and general appearance of the country; its flora, its forests, and the palæontological botany of the regions beyond, as viewed by Professor Heer and Count Saporta; its fauna, with notices of game, and with copious lists of coleoptera and lepidoptera, found there by Forst-Meister Gunther, of Petrozavodsk.

VI.—*Forestry in the Mining Districts of the Ural Mountains in Eastern Russia.*

Information is in this volume supplied in regard to forest exploitation in the government of Ufa; an account of the country passed through in a journey thither from St. Petersburg, and of mishaps and difficulties experienced in travelling there; information in regard to the country and people to the east of the Ural Mountains; the metallurgic works there established; the mines and forests in the Ural Mountain Range; the forest exploitation of the region; abuses practiced in connection with this; and conditions occasioning a diminished supply of wood; with glimpses of life in the district; of the cou-

dition of the labouring population ; and notices of the Russian conquest of Siberia.

VII.—*Forests and Forestry in Poland, in Lithuania, in the Ukraine, and in the Baltic Provinces of Russia ; with Notices of the Export of Timber from Memel, Dantzic, and Riga.*

In relation to Poland information is supplied in regard to the journey thither from St. Petersburg ; the history of Poland ; the area, distribution, management, exploitation, and produce of the forests in the Vice-Royalty ; its Schools of Forestry ; and forestal literature. In relation to Lithuania information is supplied in regard to the country and its people, and the Jewish population, who traffic largely in forest produce ; in regard to the forests of the Dnieper ; forest exploitation ; and forest game. There follow accounts of the forests of the Ukraine, and of the appearance of the country ; of the timber exports by the Baltic ; and the forest lands, forest administration, and general appearances at different seasons of the Russian Baltic Provinces of Courland, Livonia, and Estonia.

VIII.—*French Forest Ordinance of 1669 ; with Historical Sketch of Previous Treatment of Forests in France.*

The early history of forests in France is given, with details of devastations of these going on in the first half of the seventeenth century ; with a translation of the Ordinance of 1669, which is the basis of modern forest economy ; and notices of forest exploitation in *Jardinage*, in *La Methode á Tire et Aire*, and in *La Methode des Compartements*.

Besides these, I had previously published on subjects connected with Forest Science and Forest Economy :—

I.—*Pine Plantations on Sand Wastes in France.*

In this are detailed the appearances presented by the Landes of the Gironde before and after culture, and the Landes of La Sologne ; the legislation and literature of France in regard to the planting of the Landes with trees ; the characteristics of the sand wastes ; the natural history, culture, and exploitation of the maritime pine, and of the Scots fir ; and the diseases and injurious influences to which the maritime pine is subject.

*II.—Reboisement in France; or, Records of the Re-planting of the Alps, the Cevennes, and the Pyrenees, with Trees, Herbage, and Bush, with a view to arresting and preventing the destructive consequences of torrents.*

In this are given a *resumé* of Surell's study of Alpine torrents, of the literature of France relative to Alpine torrents, and of remedial measures which have been proposed for adoption to prevent the disastrous consequences following from them—translations of documents and enactments, showing what legislative and executive measures have been taken by the Government of France in connection with *réboisement* as a remedial application against destructive torrents—and details in regard to the past, present, and prospective aspects of the work.

*III.—Forests and Moisture; or Effects of Forests on Humidity of Climate.*

In this are given details of phenomena of vegetation on which the meteorological effects of forests affecting the humidity of climate depend—of the effects of forests on the humidity of the atmosphere, and on the humidity of the ground, on marshes, on the moisture of a wide expanse of country, on the local rainfall and on rivers—and of the correspondence between the distribution of the rainfall and of forests—the measure of correspondence between the distribution of the rainfall and that of forests—the distribution of the rainfall dependent on geographical position, or determined by the contour of a country—the distribution of forests affected by the distribution of the rainfall—and the local effects of forests on the subsequent distribution of the rainfall within the forest district.

*IV.—Hydrology of South Africa; or Details of the Former Hydrographic Condition of the Cape of Good Hope, and of Causes of its Present Aridity, with Suggestions of Appropriate Remedies for this Aridity.*

In this the desiccation of South Africa, from pre-Adamic times to the present day, is traced by indications supplied by geological formations, by the physical geography or the general contour of the country, and by arborescent productions in the interior, with results confirmatory of the opinion that the appropriate remedies are irrigation, arboriculture, and an improved forest economy: or the erection of dams to prevent the escape of a portion of the rainfall to the sea—the abandon-

ment or restriction of the burning of the herbage and bush in connection with pastoral and agricultural operations—the conservation and extension of existing forests—and the adoption of measures similar to the *réboisement* and *gazonnement* carried out in France, with a view to prevent the formation of torrents, and the destruction of property occasioned by them.

V.—*Water Supply of South Africa, and Facilities for the Storage of it.*

In this volume are detailed meteorological observations on the humidity of the air and the rainfall, on clouds, and winds, and thunder-storms; sources from which is derived the supply of moisture which is at present available for agricultural operations in the Colony of the Cape of Good Hope and regions beyond, embracing the atmosphere, the rainfall, rivers, fountains, subterranean streams and reservoirs, and the sea; and the supply of water and facilities for the storage of it in each of the divisions of the colony—in Basutoland, in the Orange River Free States, in Griqualand West, in the Transvaal Territory, in Zululand, at Natal, and in the Transkei Territory.

In view of the requirements of South Africa, with a view to the development of its agricultural capabilities, I have also prepared and placed at the service of the Government and community of the Colony of the Cape of Good Hope, like reports to these on forestal engineering in Spain; on hydraulic engineering in Spain; on the forest industries of Spain; on the phylloxera in Spain, with details of the invasion of Europe by it, and reports of measures of defence adopted in different countries against its devastations; and on the locust in Spain and Southern Europe, Asia, Northern Africa, South Africa and America. Together with special reports on forestal, hydraulic, and agricultural requirements of the Colony.

Amongst the reports procured by the Executive Committee of the Edinburgh International Forestry Exhibition is an exhaustive one on the forestal literature of other lands, and English works exhibited there, prepared by the jurors appointed to report on these.



Not a little has been done by members of the forest service of India to make their acquirements of knowledge and of forestal skill subservient to the advancement of forestry in other lands besides India. Amongst other names which suggest themselves at once are those of Dr Cleghorn, Colonel Walker Campbell, Colonel Michael, and Colonel Pearson; and good service is being done by the *Indian Forester*, a valuable periodical.

It is impossible to speak in too high terms of treatises published by the late Baron Von Mueller, of Victoria. Most valuable practical information is embodied in Reports, Memoirs, and Manuals, issued by Mr J. E. Brown, Conservator of Forests for the Government of South Australia. And the forest reports annually published in various of our Colonies, and the official reports issued by the Government of the United States of America, are producing a large and valuable body of forestal literature in the English language.

Besides these, many valuable treatises on subjects connected with forestry, and pertaining to forest science, have been published both in Britain and in America. Several of these are known to me, and highly valued by me, but I am not able to supply a complete list of the works which have been published; and it might seem invidious, and prove misleading, were I to give a partial list, and it is such alone which I could supply.

We have an extensive and valuable literature relative to Arboriculture. For this there is, and ever has been, a demand; but with works on Sylviculture, Modern Forest Science, and Modern Forest Economy, it is otherwise. Nor is there yet such a demand for works of this kind as would make it pecuniarily remunerative to any to engage largely in the publication of such works; but as the demand increases so will the supply.

But a beginning has been made. In so far as I have taken part in this I have done so in anticipation of a future demand, not in consequence of any manifestation of a felt want. And in reference to the rapid supply of

works on forestry in the Spanish language of late years, which I have noted, I may remark that this did not occur until after several successive batches of students had entered upon the active duties of their profession. It was then that it became manifest wherein the existing forestal literature of the country was deficient in view of the requirements of the day; and that the desire for information induced purchase and perusal. And it is noteworthy that even still in connection with the publication of almost all of the Spanish works referred to, including the most expensive and least popular of them, the writers were relieved of the expense of publication. It is not so with us.

To quote again from my "Plea for the Establishment of a School of Forestry in connection with the Arboretum in Edinburgh":—

'I have been asked—How has it come to pass that so little has been done in Britain, while so much has been done on the Continent of Europe, to raise up a body of foresters, highly educated for the discharge of their duties? My answer must be—Hitherto the problem to be solved in Britain did not require the amount of information which was required for the solution of the complicated problems demanding solution there. On the Continent they were threatened in many quarters with a lack of fuel, with a lack of timber, with ruinous desiccation, and with destructive torrents, all consequent on the destruction of their forests, and with the devastation of fertile lands by drift sands, which could only be arrested and utilised by the planting of trees. In Britain we find fuel in our coal mines, and in many country districts in our peat bogs; excepting for a short time about the beginning of the present century, when war was raging, we could get timber of every description from beyond the sea; and we know little of drought, of torrents, and of drift sands, and the difference has even told upon our language. While our French neighbours speak of *Sylviculture*, the culture of woods, we speak of *Arboriculture*, the culture of trees.

While they, in speaking of *Les Forêts* and of *La Code Forestière*, refer to a country covered more or less with trees, we, in speaking of *The Green Wood* and of *Forestry*, hitherto have thought chiefly of the game and of the chase, or of the shooting of deer. Our forest laws relate mainly, if I may not say exclusively, to hunting, these laws having nothing to do with shrubs and trees, excepting in so far as they may supply shelter or covert for game. I speak advisedly when I say, that, according to the technical use of the term in English law, a forest need not contain a single tree, and a dozen of contiguous counties might be covered with trees without these constituting a forest. The totally different circumstances in which the different countries have stood in regard to the requirements of forest products account for the difference in the attention hitherto given on the Continent and in Britain to the study of what is known there as Forest Science.

‘It may be asked, seeing it is so – Why should we not go on as we have been doing hitherto? The answer is – in our Colonies, and in the Indian Empire of India, evils which have existed long are being experienced and remedied; and those whom the country would engage to go forth to meet the evils must go, at the country’s expense, to acquire the necessary education in other lands, and in a foreign language unknown to most young gardeners and foresters, and sons of foresters, whose life has been spent in connection with the management of trees, and which is so taught in many of our schools, that few even of the young men of our country who have had a liberal education could understand instruction given in it as they could instruction given in their own tongue.’

The pecuniary returns, I may add, are likely far to exceed in amount the expenditure likely to be incurred.

In the years 1860-64, during which years I held the office of Colonial botanist, and thus had my attention directed to this matter, the annual revenue derived from

the whole of the Crown forests at the Cape of Good Hope was then only about £250 a year in excess of the expenditure on what was called *the conservation*, but included a wasteful sale of the produce; and thereafter the free revenue rapidly diminished, and the forests were rapidly disappearing. But latterly Count de Vasselot, an *élève* of the Forest School of Nancy, was appointed Commissioner of Forests in the Colony; and from a Colonial notice of an official report of his, it appears that these Crown forests, if regularly worked, would produce a yearly revenue of £235,000!

At the time referred to (1863-64) comparatively little was being done to obtain the greatest possible good from the Colonial forests of South Australia. In the interval the defence, exploitation, and extension of these forests has been entrusted to Mr J. E. Brown as Conservator of Forests. For eight years past there has been expended on these works, under his advice, well-nigh £6000 a year; but this has been repaid within a small amount by revenue derived from the forests; while the value of the permanent improvements and extension of the forests is estimated at £100,000.

Again, from a statement in the *Indian Pioneer*, it appears that the Indian forest revenue for official year (1883-84) amounted to £1,040,000, and the charges to about £600,000, leaving a clear revenue of £440,000. In France the revenue and expenditure of the forest department were £1,405,104 and £641,508, according to a quotation by Dr Brandis. But the French State forests cover less than 4000 square miles. Those of the Indian Government, including the second-class reserves, cover over 89,000 square miles, and a large proportion of the expenditure in India is occasioned by extensive plantations. In Prussia, from 10,000 square miles of State forests, there is derived a net gain of nearly a million sterling annually.













